Cisco ONS 15600 Reference Manual

Product and Documentation Release 7.2
Last Updated: August 2012

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About this Manual

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This section explains the objectives, intended audience, conventions, related documentation, and technical assistance information for the *Cisco ONS 15600 Reference Manual*.

This section provides the following information:

- Revision History
- Document Objectives
- Audience
- Related Documentation
- Document Conventions
- Obtaining Optical Networking Information
- Obtaining Documentation and Submitting a Service Request

Revision History

Date	Notes
March 2007	Revision History Table added for the first time
August 2007	Updated voltage and current rating in section A.1.15 Power Specifications.
September 2008	Added a note in Card Default Settings and Node Default Settings section of Appendix C, Network Element Defaults.
April 2010	Updated the section “SNMP Overview” in the chapter “SNMP”.
November 2011	Updated the section “Path Trace” in the chapter “Circuits and Tunnels”.
April 2012	Added the section “ASAP Card Cables” in the chapter, “Self and Backplane Hardware”.
August 2012	The full length book-PDF was generated.

Document Objectives

The *Cisco ONS 15600 Reference Manual* provides technical information for the Cisco ONS 15600.

Use the manual in conjunction with the appropriate publications listed in the Related Documentation section.

Audience

To use this reference manual you should be familiar with Cisco or equivalent optical transmission equipment.

Related Documentation

Use the *Cisco ONS 15600 Reference Manual* in conjunction with the following referenced publications:

- *Cisco ONS 15600 Procedure Guide*
  Provides installation, turn up, test, and maintenance procedures.
- *Cisco ONS 15600 Troubleshooting Guide*
  Provides alarm descriptions and troubleshooting procedures, general troubleshooting procedures, error messages, and transient conditions.
- *Cisco ONS SONET TL1 Command Guide*
  Provides a full TL1 command and autonomous message set including parameters, AIDs, conditions and modifiers for the Cisco ONS 15454, ONS 15327, ONS 15600, ONS 15310-CL, and Cisco ONS 15310-MA systems.
- *Cisco ONS SONET TL1 Reference Guide*
  Provides general information, procedures, and errors for TL1 in the ONS 15454, ONS 15327, ONS 15600, ONS 15310-CL, and ONS 15310-MA systems.
- *Release Notes for the Cisco ONS 15600 Release 7.2*
  Provides caveats, closed issues, and new features and functionality information.

For an update on End-of-Life and End-of-Sale notices, refer to http://cisco.com/en/US/products/hw/optical/ps4533/prod_eol_notices_list.html.

Document Conventions

This publication uses the following conventions:

Convention	Application
boldface	Commands and keywords in body text.
italic	Command input that is supplied by the user.
[ ]	Keywords or arguments that appear within square brackets are optional.
{ x | x | x }	A choice of keywords (represented by x) appears in braces separated by vertical bars. The user must select one.
Ctrl	The control key. For example, where Ctrl + D is written, hold down the Control key while pressing the D key.
`screen font`	Examples of information displayed on the screen.
`boldface screen font`	Examples of information that the user must enter.
< >	Command parameters that must be replaced by module-specific codes.

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document.

Caution Means *reader be careful*. In this situation, the user might do something that could result in equipment damage or loss of data.

Warning **IMPORTANT SAFETY INSTRUCTIONS**

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

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Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di intervenire su qualsiasi apparecchiatura, occorre essere al corrente dei pericoli relativi ai circuiti elettrici e conoscere le procedure standard per la prevenzione di incidenti. Utilizzare il numero di istruzione presente alla fine di ciascuna avvertenza per individuare le traduzioni delle avvertenze riportate in questo documento.

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СОХРАНИТЕ ЭТИ ИНСТРУКЦИИ

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이 지시 사항을 보관하십시오.

Aviso **INSTRUÇÕES IMPORTANTES DE SEGURANÇA**

Este símbolo de aviso significa perigo. Você se encontra em uma situação em que há risco de lesões corporais. Antes de trabalhar com qualquer equipamento, esteja ciente dos riscos que envolvem os circuitos elétricos e familiarize-se com as práticas padrão de prevenção de acidentes. Use o número da declaração fornecido ao final de cada aviso para localizar sua tradução nos avisos de segurança traduzidos que acompanham o dispositivo.

GUARDE ESTAS INSTRUÇÕES

Advarsel **VIGTIGE SIKKERHEDSANVISNINGER**

Dette advarselssymbol betyder fare. Du befinder dig i en situation med risiko for legemesbeskadigelse. Før du begynder arbejde på udstyr, skal du være opmærksom på de involverede risici, der er ved elektriske kredsløb, og du skal sætte dig ind i standardprocedurer til undgåelse af ulykker. Brug erklæringsnummeret efter hver advarsel for at finde oversættelsen i de oversatte advarsler, der fulgte med denne enhed.

GEM DISSE ANVISNINGER

تحذير **إرشادات الأمان الهامة**

يوضح رمز التحذير هذا وجود خطر. وهذا يعني أنك متواجد في مكان قد ينتج عنه التعرض لإصابات. قبل بدء العمل، احذر مخاطر التعرض للصدمات الكهربائية وكن على علم بالإجراءات القياسية للحيلولة دون وقوع أي حوادث. استخدم رقم البيان الموجود في أخر كل تحذير لتحديد مكان ترجمته داخل تحذيرات الأمان المترجمة التي تأتي مع الجهاز.

قم بحفظ هذه الإرشادات

Upozorenje **VAŽNE SIGURNOSNE NAPOMENE**

Ovaj simbol upozorenja predstavlja opasnost. Nalazite se u situaciji koja može prouzročiti tjelesne ozljede. Prije rada s bilo kojim uređajem, morate razumjeti opasnosti vezane uz električne sklopove, te biti upoznati sa standardnim načinima izbjegavanja nesreća. U prevedenim sigurnosnim upozorenjima, priloženima uz uređaj, možete prema broju koji se nalazi uz pojedino upozorenje pronaći i njegov prijevod.

SAČUVAJTE OVE UPUTE

Upozornění **DŮLEŽITÉ BEZPEČNOSTNÍ POKYNY**

Tento upozorňující symbol označuje nebezpečí. Jste v situaci, která by mohla způsobit nebezpečí úrazu. Před prací na jakémkoliv vybavení si uvědomte nebezpečí související s elektrickými obvody a seznamte se se standardními opatřeními pro předcházení úrazům. Podle čísla na konci každého upozornění vyhledejte jeho překlad v přeložených bezpečnostních upozorněních, která jsou přiložena k zařízení.

USCHOVEJTE TYTO POKYNY

Προειδοποίηση

ΣΗΜΑΝΤΙΚΕΣ ΟΔΗΓΙΕΣ ΑΣΦΑΛΕΙΑΣ

Αυτό το προειδοποιητικό σύμβολο σημαίνει κίνδυνο. Βρίσκεστε σε κατάσταση που μπορεί να προκαλέσει τραυματισμό. Πριν εργαστείτε σε οποιοδήποτε εξοπλισμό, να έχετε υπόψη σας τους κινδύνους που σχετίζονται με τα ηλεκτρικά κυκλώματα και να έχετε εξοικειωθεί με τις συνήθεις πρακτικές για την αποφυγή ατυχημάτων. Χρησιμοποιήστε τον αριθμό δήλωσης που παρέχεται στο τέλος κάθε προειδοποίησης, για να εντοπίσετε τη μετάφρασή της στις μεταφρασμένες προειδοποιήσεις ασφαλείας που συνοδεύουν τη συσκευή.

ΦΥΛΑΞΤΕ ΑΥΤΕΣ ΤΙΣ ΟΔΗΓΙΕΣ

אזהרה

הוראות בטיחות חשובות

סימן אזהרה זה מסמל סכנה. אתה נמצא במצב העלול לגרום לפציעה. לפני שתעבוד עם ציוד כלשהו, עליך להיות מודע לסכנות הכרוכות במעגלים חשמליים ולהכיר את הנהלים המקובלים למניעת תאונות. השתמש במספר ההוראה המסופק בסופה של כל אזהרה כד לאתר את התרגום באזהרות הבטיחות המתורגמות שמצורפות להתקן.

שמור הוראות אלה

Opomena

ВАЖНИ БЕЗБЕДНОСНИ НАПАТСТВИЈА

Симболот за предупредување значи опасност. Се наоѓате во ситуација што може да предизвика телесни повреди. Пред да работите со опремата, бидете свесни за ризикот што постои кај електричните кола и треба да ги познавате стандардните постапки за спречување на несреќни случаи. Искористете го бројот на изјавата што се наоѓа на крајот на секое предупредување за да го најдете неговиот период во преведените безбедносни предупредувања што се испорачани со уредот.

ЧУВАЈТЕ ГИ ОВИЕ НАПАТСТВИЈА

Ostrzeżenie

WAŻNE INSTRUKCJE DOTYCZĄCE BEZPIECZEŃSTWA

Ten symbol ostrzeżenia oznacza niebezpieczeństwo. Zachodzi sytuacja, która może powodować obrażenia ciała. Przed przystąpieniem do prac przy urządzeniach należy zapoznać się z zagrożeniami związanymi z układami elektrycznymi oraz ze standardowymi środkami zapobiegania wypadkom. Na końcu każdego ostrzeżenia podano numer, na podstawie którego można odszukać tłumaczenie tego ostrzeżenia w dołączonym do urządzenia dokumencie z tłumaczeniami ostrzeżeń.

NINIEJSZE INSTRUKCJE NALEŻY ZACHOWAĆ

Upozornenie

DÔLEŽITÉ BEZPEČNOSTNÉ POKYNY

Tento varovný symbol označuje nebezpečenstvo. Nachádzate sa v situácii s nebezpečenstvom úrazu. Pred prácou na akomkoľvek vybavení si uvedomte nebezpečenstvo súvisiace s elektrickými obvodmi a oboznámte sa so štandardnými opatreniami na predchádzanie úrazom. Podľa čísla na konci každého upozornenia vyhľadajte jeho preklad v preložených bezpečnostných upozorneniach, ktoré sú priložené k zariadeniu.

USCHOVAJTE SI TENTO NÁVOD

Obtaining Optical Networking Information

This section contains information that is specific to optical networking products. For information that pertains to all of Cisco, refer to the Obtaining Documentation and Submitting a Service Request section.

Where to Find Safety and Warning Information

For safety and warning information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document that accompanied the product. This publication describes the international agency compliance and safety information for the Cisco ONS 15454 system. It also includes translations of the safety warnings that appear in the ONS 15454 system documentation.

Cisco Optical Networking Product Documentation CD-ROM

Optical networking-related documentation, including Cisco ONS 15xxx product documentation, is available in a CD-ROM package that ships with your product. The Optical Networking Product Documentation CD-ROM is updated periodically and may be more current than printed documentation.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation,* which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

Shelf and Backplane Hardware

This chapter provides a description of Cisco ONS 15600 shelf and backplane hardware. Card and cable descriptions are provided in Chapter 2, "Card Reference."

To install equipment, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 1.1 Installation Overview, page 1-1
- 1.2 Bay Installation, page 1-2
- 1.3 Front Door, page 1-4
- 1.4 Rear Covers, page 1-5
- 1.5 Cable Routing, page 1-7
- 1.6 Customer Access Panel, page 1-7
- 1.7 Alarm, Timing, LAN, and Craft Pin Connections, page 1-10
- 1.8 Power Distribution Unit, page 1-13
- 1.9 Power and Ground Description, page 1-13
- 1.10 Fan-Tray Assembly, page 1-15
- 1.11 Cards and Slots, page 1-17

Note The Cisco ONS 15600 assembly is intended for use with telecommunications equipment only.

Note The ONS 15600 is designed to comply with Telcordia GR-1089-CORE Type 2 and Type 4 equipment. Install and operate the ONS 15600 only in environments that do not expose wiring or cabling to the outside plant. Acceptable applications include Central Office Environments (COEs), Electronic Equipment Enclosures (EEEs), Controlled Environment Vaults (CEVs), huts, and Customer Premise Environments (CPEs).

1.1 Installation Overview

The ONS 15600 is a Network Equipment Building System III (NEBS III)-compliant, environmentally hardened shelf assembly that ships as a single shelf in a bay assembly for Release 7.2. The ONS 15600 comes with the power distribution unit (PDU), shelf, fans, and backplane already installed. The front

door of the ONS 15600 allows access to the shelf assembly, fan-tray assembly, and cable-management area. The customer access panel (CAP) on the back of the shelf provides access to alarm contacts, external interface contacts, and timing contacts. Power and ground terminals are located on the top left and right sides of the bay.

Caution Voltage to the alarm circuits should not exceed –48 VDC.

The ONS 15600 comes mounted in a custom, certified NEBS-2000 rack. The bay assembly, including the rack, fan trays, and PDU weighs approximately 500 pounds (226.8 kg) with no cards installed.

ONS 15600 OC-N cards have OGI connectors on the card faceplate; available connector termination types are SC, ST, and FC. Fiber optic cables are routed to the front of the OC-N cards.

The ONS 15600 is powered using –48 VDC power but may range from –40.5 to –72 VDC. Input power is accessible from the sides of the bay, and output power is accessible at the rear of the bay. Cisco supports dual office-power feeds only.

Install the ONS 15600 in compliance with your local and national electrical codes:

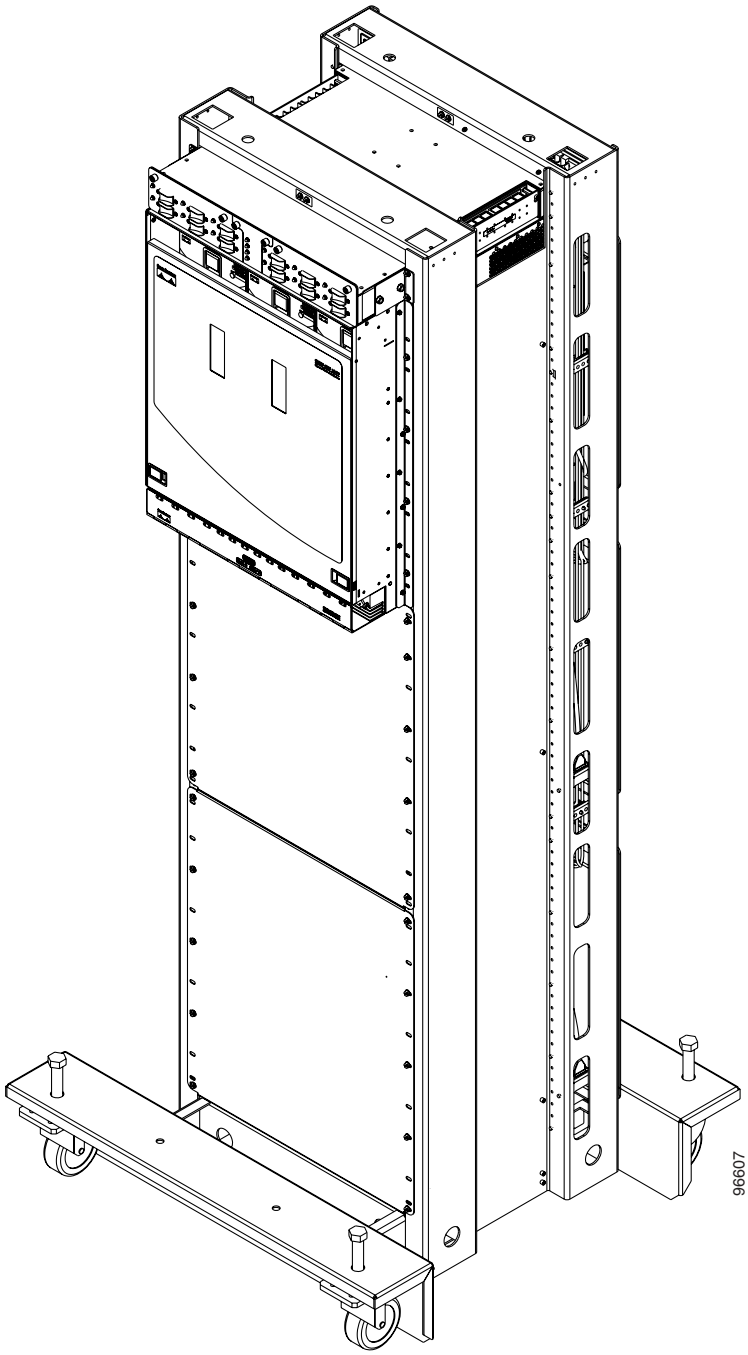
- United States: National Fire Protection Association (NFPA) 70; United States National Electrical Code
- Canada: Canadian Electrical Code, Part I, CSA C22.1
- Other countries: If local and national electrical codes are not available, refer to IEC 364, Part 1 through Part 7.

1.2 Bay Installation

In this chapter, the terms “ONS 15600” and “bay assembly” are used interchangeably. In the installation context, these terms have the same meaning. Otherwise, bay assembly refers to the physical steel enclosure that holds the shelves and power distribution unit (PDU), and ONS 15600 refers to the entire system, both hardware and software.

To install the ONS 15600, you must first unpack the bay assembly. Two custom ramps and two dollies are available to assist you with the removal of the bay from the shipping pallet and transportation to the installation location. Figure 1-1 shows the bay assembly with the dollies installed.

Figure 1-1 ONS 15600 with Dollies Installed



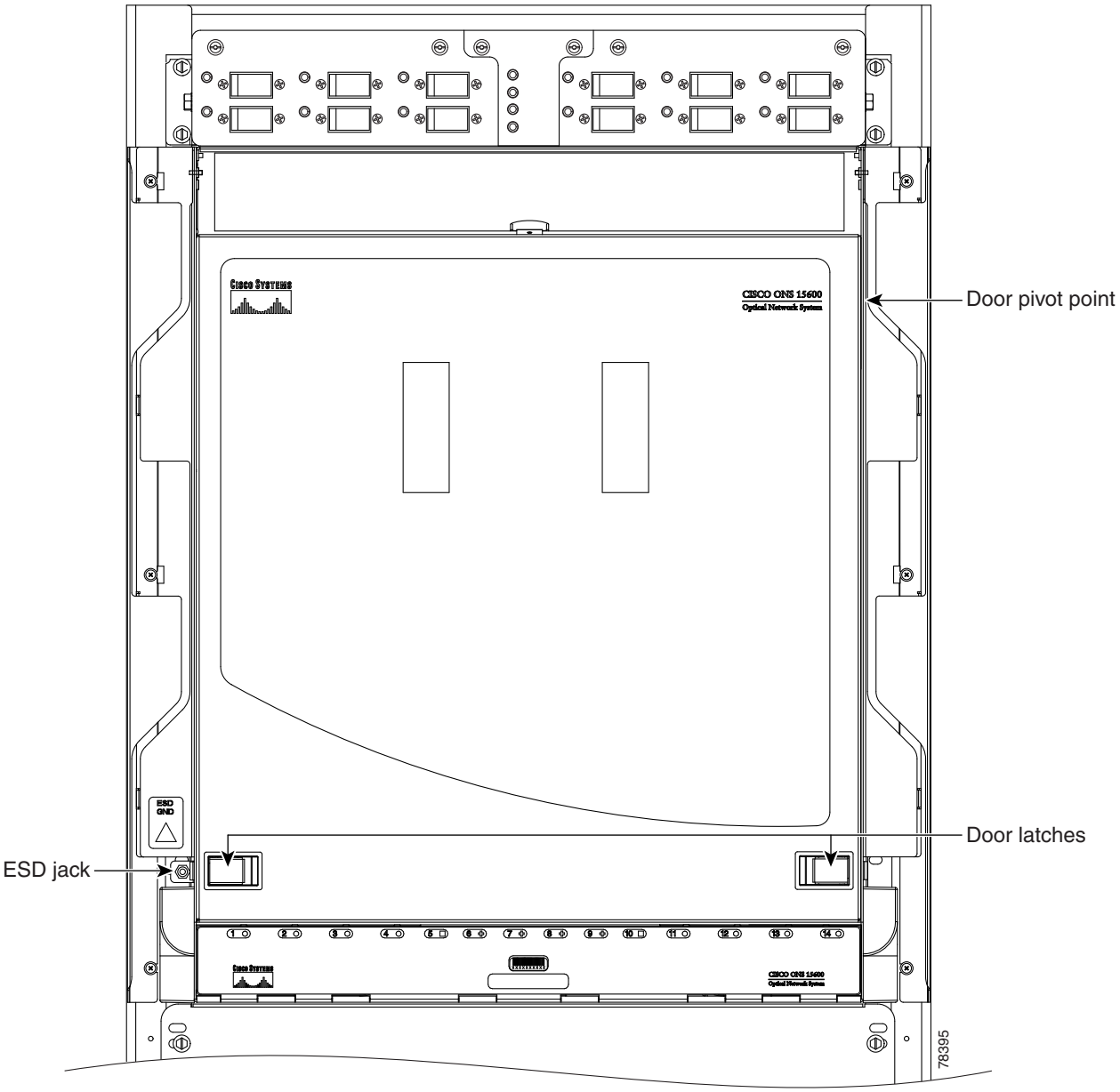
The ONS 15600 shelf measures 25 inches high, 19-9/16 inches wide, and 23 inches deep (63.5 cm H x 49.7 cm W x58.3 cm D). A maximum of three ONS 15600s can fit in a custom seven-foot equipment rack. The ONS 15600 that ships within a rack is 83-7/8 inches high, 23-5/8 inches wide, and 23-5/8 inches deep (213 cm H x 60 cm W x 60 cm D).

Note Cisco supports only one ONS 15600 shelf per bay.

1.3 Front Door

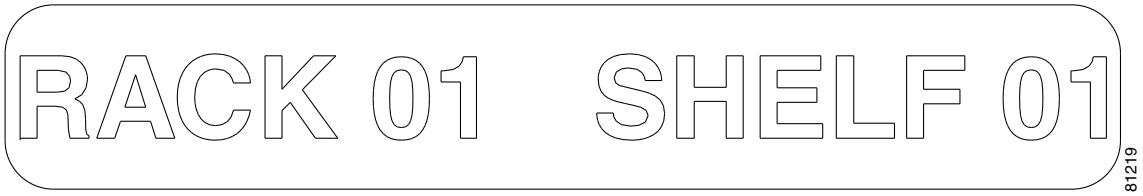
The ONS 15600 features a door to the front compartment that you can open by releasing the latches on the bottom left and right sides of the door. The front door provides access to the shelf, cable-management tray, and fans (Figure 1-2).

Figure 1-2 ONS 15600 Front Door



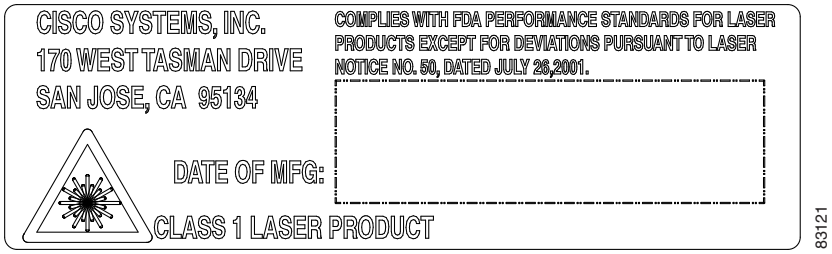
You can remove the front door of the ONS 15600 to provide unrestricted access to the front of the shelf. A label is pasted in a box in the center of the swing-down door that covers the fiber routers (Figure 1-3). This label designates the position of the rack and shelf in a lineup.

Figure 1-3 Bay Label



The front door also has a Class I laser warning (Figure 1-4).

Figure 1-4 Laser Warning Label


CISCO SYSTEMS, INC.
170 WEST TASMAN DRIVE
SAN JOSE, CA 95134
COMPLIES WITH FDA PERFORMANCE STANDARDS FOR LASER PRODUCTS EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JULY 26,2001.
DATE OF MFG:
CLASS 1 LASER PRODUCT
83121

1.4 Rear Covers

The ONS 15600 has an optional plastic rear cover that is held in place with six 6-32 x 3/8 inch Phillips screws. This plastic cover provides additional protection for the cables and connectors on the backplane (Figure 1-5).

Figure 1-5 Plastic Rear Cover

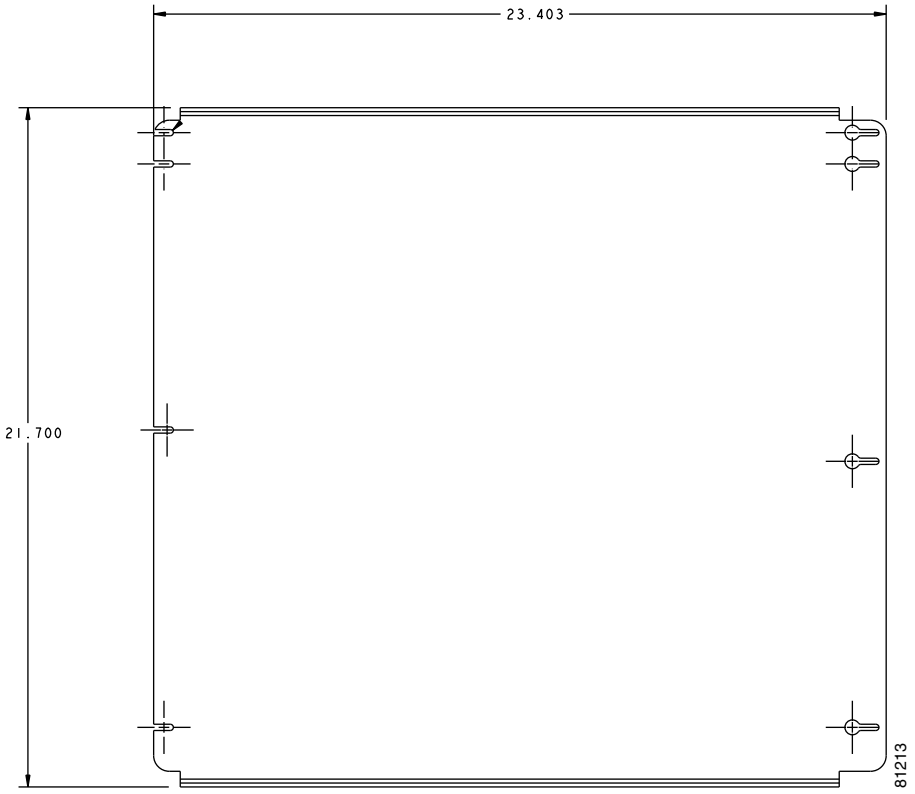
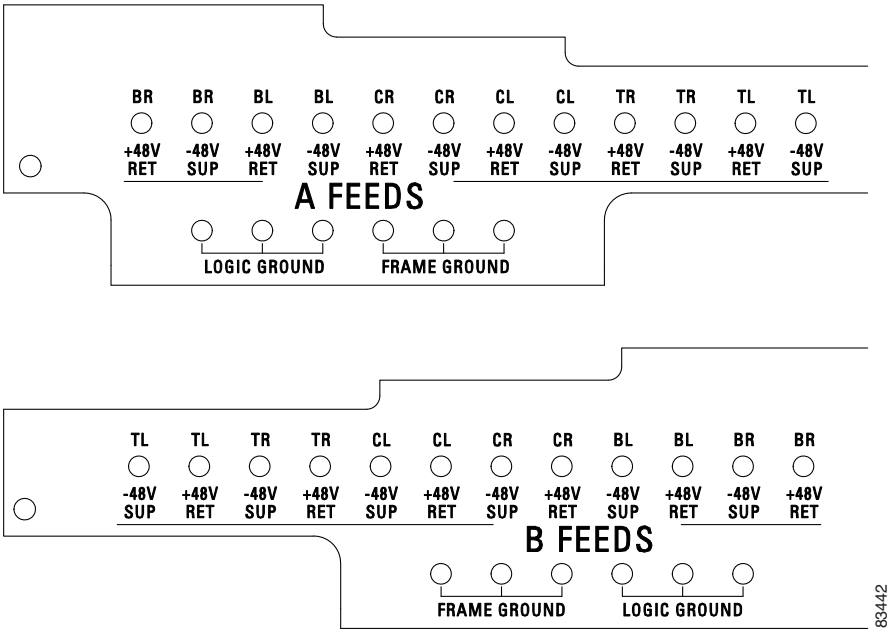


Figure 1-6 shows the bus bar covers.

Figure 1-6 PDU Bus Bar Cover


BR BR BL BL CR CR CL CL TR TR TL TL
+48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP
A FEEDS
LOGIC GROUND
FRAME GROUND
TL TL TR TR CL CL CR CR BL BL BR BR
-48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET -48V SUP +48V RET
B FEEDS
FRAME GROUND
LOGIC GROUND
83442

1.5 Cable Routing

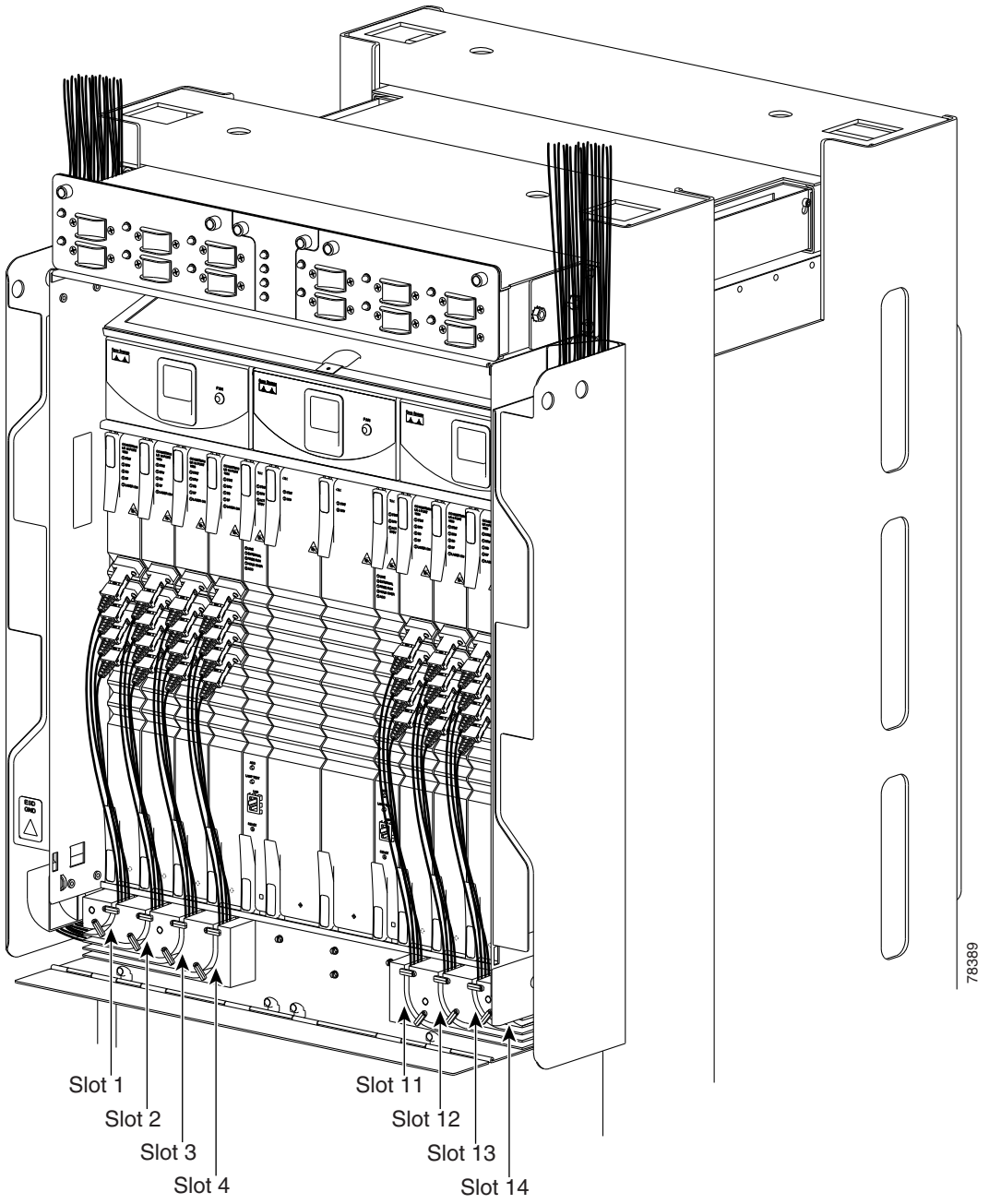
The narrow and wide cable routing modules (CRMs) can be installed on the sides of the bay to manage and contain the optical cables as they are routed away from the bay. You can use both types of fiber routing systems with overhead or under-floor cabling.

1.6 Customer Access Panel

The Customer Access Panel (CAP) is located in the middle of the rear of the shelf. The CAP provides an alarm pin field, timing, and LAN connections. The CAP plugs into the backplane using 2mm Hard Metric connectors with 752 pins and is held in place with one large captive bolt and multiple screws. Figure 1-7 shows the location of the CAP on the back of the shelf.

Note The ONS 15600 supports only T1 (100 ohm) building integrated timing supply (BITS).

Figure 1-7 Rear of the ONS 15600, Including the CAP



The ONS 15600 CAP provides the following:

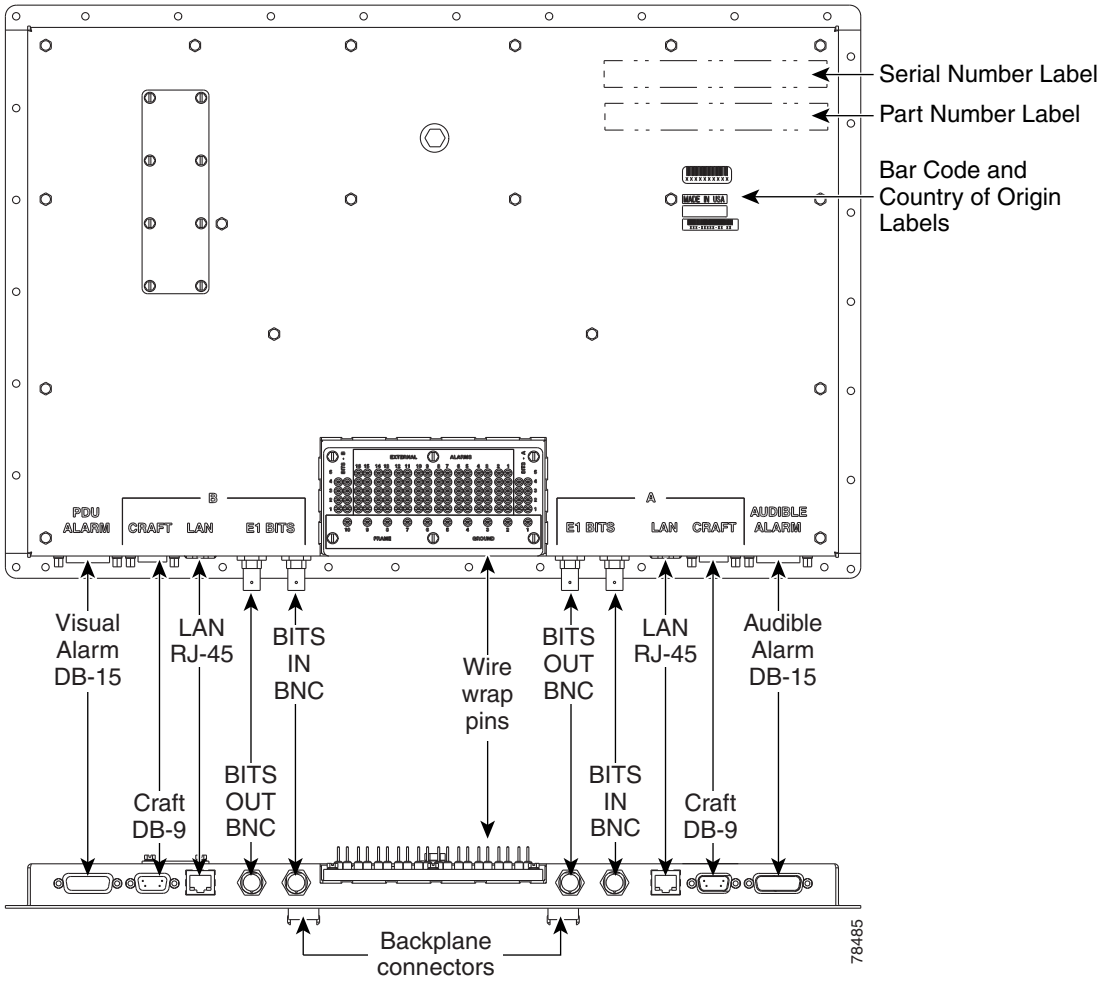
- BITS T1 (100 ohm) interfaces via wire-wrap pins.
- Two Ethernet interfaces via RJ-45 connectors with internal transformer isolation.
- An EIA/TIA-232 craft interface via DB-9 connectors. This interface is surge-protected and provides EMI filtering. Two interfaces are provided for redundancy.

- Four audio alarm interfaces via a DB-15 connector that is surge-protected and EMI-filtered. The audio alarm indication is provided by the Timing and Shelf Controller (TSC) card and this interface can receive a signal to disable the audio alarm.
- Four visual alarm interfaces via a DB-15 connector that is surge-protected and EMI-filtered. The visual alarm indication is provided by the TSC card and the signal is connected to the PDU where LEDs indicate the alarm status and severity.
- Environmental (external) alarms and controls (16 inputs and 16 outputs) via wire-wrap pins. The interface is surge-protected and provides isolation by using an opto-isolator for alarm inputs and relays for alarm outputs. By connecting to different wire-wrap pins on the CAP, the alarm outputs can be configured for either normally open (NO) or normally closed (NC) operation. Alarms are initiated by shorting these contacts. The alarm input interface provides a pair of positive and negative wire-wrap pins.

The isolation and termination meet the intra-building lightning surge specified in Telcordia GR-1089. The CAP has –48 VDC monitoring with I^2C interface and nonvolatile memory to store the CAP revision information.

Figure 1-8 shows the CAP faceplate.

Figure 1-8 CAP Faceplate and Connections



If the CAP fails, the node raises an EQPT alarm. You can replace the CAP on an in-service system without affecting traffic. To replace a CAP, refer to the *Cisco ONS 15600 Procedure Guide*. Always replace the CAP during a maintenance window.

1.7 Alarm, Timing, LAN, and Craft Pin Connections

Caution Always use the supplied ESD wristband when working with a powered ONS 15600 or any ONS 15600 components. Plug the wristband cable into one of the ESD jacks located on the lower-left outside edge of the bay assembly and at the bottom rear of the shelf.

The ONS 15600 has a backplane pin field located at the bottom rear of the shelf that is part of the CAP. The CAP provides 0.045 square inch (0.290 square centimeter) wire-wrap pins for enabling alarm inputs and outputs and timing input and output. This section describes the backplane pin field and pin assignments, as well as timing and LAN connections. See the "1.6 Customer Access Panel" section on page 1-7 for more information.

1.7.1 External Alarm and Control Contact Installation

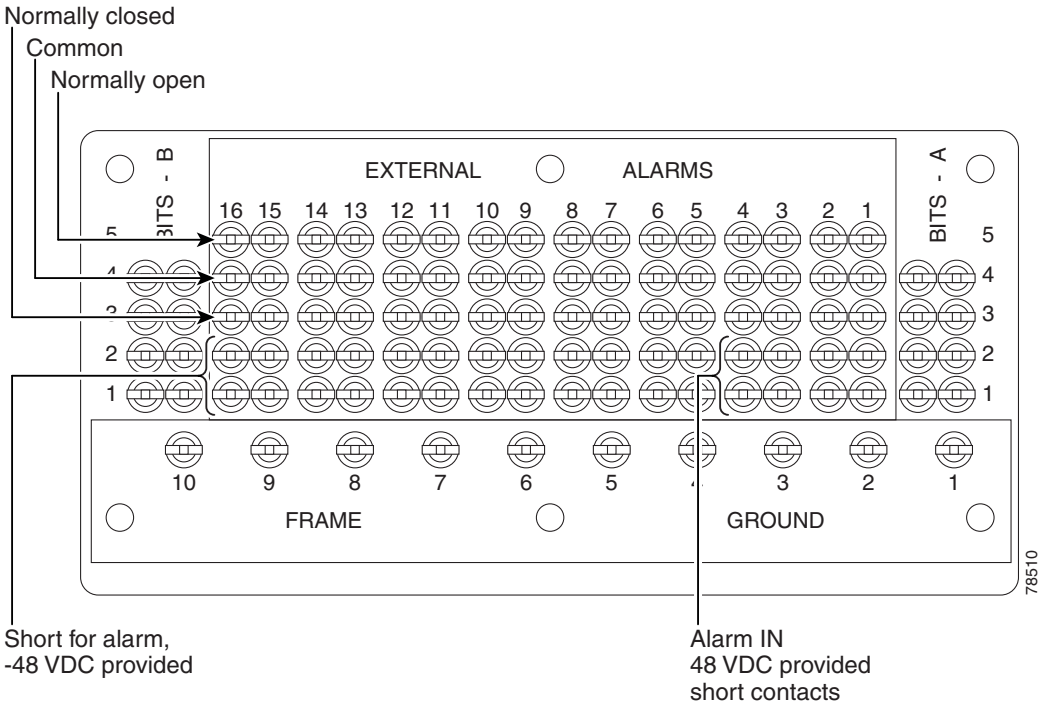
The external (environmental) alarm contacts consist of the wire-wrap pin field and two D-Sub 15s. The alarm pin field supports up to 16 alarm inputs (external alarms) and 16 alarm outputs (external controls). The two D-Sub 15s support four audible alarms, four visual alarms, one alarm cutoff (ACO), a PDU Fail A, and a PDU Fail B.

By connecting to different wire-wrap pins on the CAP, the alarm outputs can be configured for either normally open (NO) or normally closed (NC) operation (see Figure 1-9). The alarm inputs consist of two wire-wrap pins on the CAP and the alarm outputs consist of three wire-wrap pins.

1.7.1.1 Visual and Audible Alarms

Visual and audible alarm contacts are provisioned as Critical, Major, Minor, and Remote. Figure 1-9 shows alarm pin assignments.

Figure 1-9 Alarm Pin Assignments on the CAP



Visual and audible alarms can be wired to trigger an alarm light at a central alarm collection point when the corresponding contacts are closed.

1.7.1.2 Alarm Cutoff and PDU Alarms

The PDU Alarm connection controls the visual alarm indicators on the front of the PDU. You can also activate the alarm cutoff (ACO) function by pressing the ACO button on the TSC card faceplate. The ACO function extinguishes all audible alarm indications, but the alarm is still raised in Cisco Transport Controller (CTC).

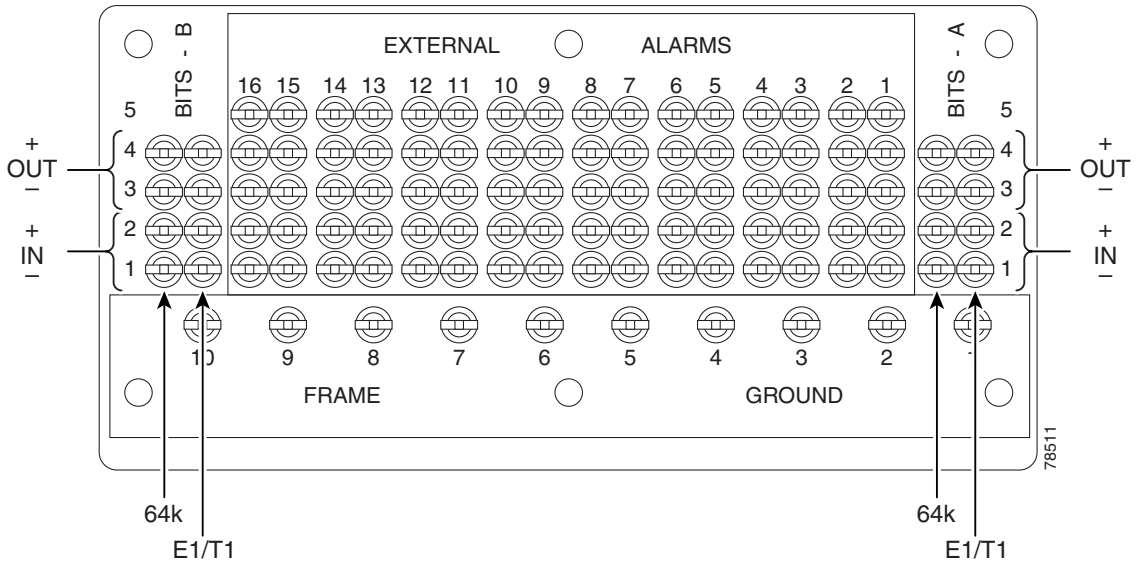
1.7.2 Timing Installation

The ONS 15600 backplane supports two 100-ohm BITS clock pin fields. Figure 1-10 shows the pin assignments for the BITS timing pin fields.

Note Refer to Telcordia SR-NWT-002224 for rules about provisioning timing references.

Note 64K and E1 timing are not used with SONET systems.

Figure 1-10 BITS Timing Connections on the CAP



See Chapter 6, "Timing," for more information.

1.7.3 LAN Installation

Use a straight-through LAN cable with the LAN port on the ONS 15600 CAP to connect the ONS 15600 to a hub, switch, or a LAN modem for remote access to the node. Use a crossover cable when connecting the CAP to a workstation. You can also use a straight-through or crossover LAN cable with the LAN port on the active TSC faceplate to connect directly to the local ONS 15600.

Note Do not use the LAN port on the active TSC card for remote monitoring because you will lose connectivity to the node if the other TSC card in the shelf becomes the active TSC card.

1.7.4 TL1 Craft Interface Installation

To open a TL1 session using the craft interface on a PC, use the RJ-45 port on the active TSC card to access the system using a standard web browser. If a browser is not available, you can access the system using one of the two EIA/TIA-232 ports on the CAP. Each EIA/TIA-232 port supports VT100 emulation so that you can enter TL1 commands directly without using a web browser. Because the CAP EIA/TIA-232 port is set up as a data terminal equipment (DTE) interface, you must use a 3-pair swapping null modem adapter when you are working in a UNIX or PC environment so that the TXD/RXC, DSR/DTR, and CTS/RTS pins are swapped. Use a standard pin D-sub cable when connecting to a PC. Refer to the *Cisco ONS SONET TL1 Command Guide* for more information.

Note Do not use the LAN port on the active TSC card for remote monitoring because you will lose connectivity to the node if the other TSC card in the shelf becomes the active TSC card.

1.8 Power Distribution Unit

The PDU consists of a mounting chassis, A- and B-side power modules, an alarm module, and a rear I/O unit. The ONS 15600 PDU has LEDs that alert you to Critical, Major, Minor, and remote alarms on the node. Each module can support three 100A input power feeds, 48 VDC power load (based on a fully loaded ONS 15600 shelf). The PDU supplies six 50A power feeds to the shelves. (The PDU provided with the ONS 15600 is capable of supplying power to up to three shelves.)

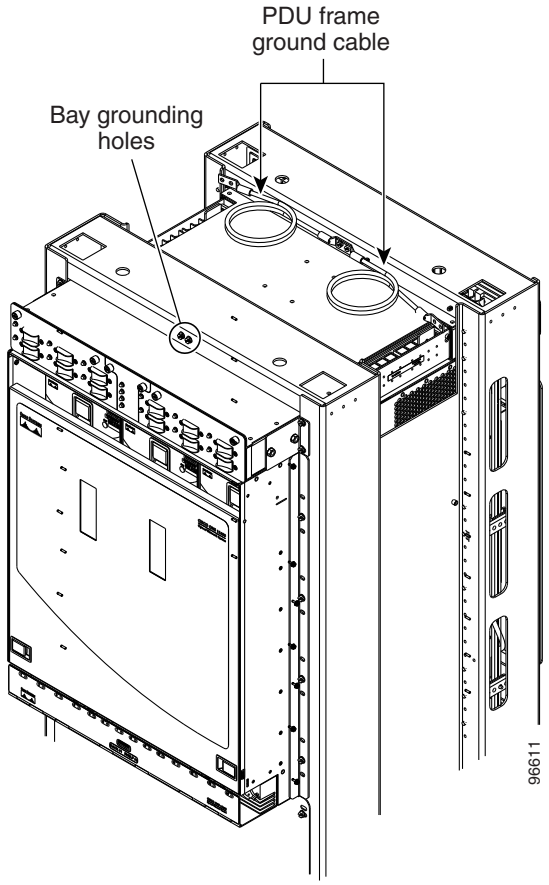
A three-shelf bay at the minimum operational voltage of –36 VDC requires 69-A per feed (207 A total). A three-shelf bay at the nominal operational voltage of –48 VDC requires 52-A per feed (156 A total). Each of the three feeds should be protected by its own 100-A breaker. A bus bar system, rather than wiring, provides a reliable, low resistance path to the ONS 15600 shelf. Figure 1-6 on page 1-7 shows the PDU output covers found at the top rear of the bay.

Note Cisco supports only one ONS 15600 shelf per bay.

1.9 Power and Ground Description

Ground the equipment according to Telcordia standards or local practices. The ground connection is located on the front of the bay's top horizontal rails. The ONS 15600 provides two #12 tapped holes to accommodate the grounding lug. The lug must be a dual-hole type and rated for at least 125-A capacity. Figure 1-11 shows the front and rear bay ground holes.

Figure 1-11 Front and Rear Bay Ground Holes



The main power connections are made at the PDU side terminals at the top of the bay. To install redundant power feeds, use four power cables and ground cables. For a single power feed, only two power cables and one ground cable (all rated for at least 125-A capacity) are required. Use a conductor with low impedance to ensure circuit overcurrent protection. The ground conductor must have the capability to safely conduct any faulty current that might be imposed.

Cisco recommends the following wiring conventions, but customer conventions prevail:

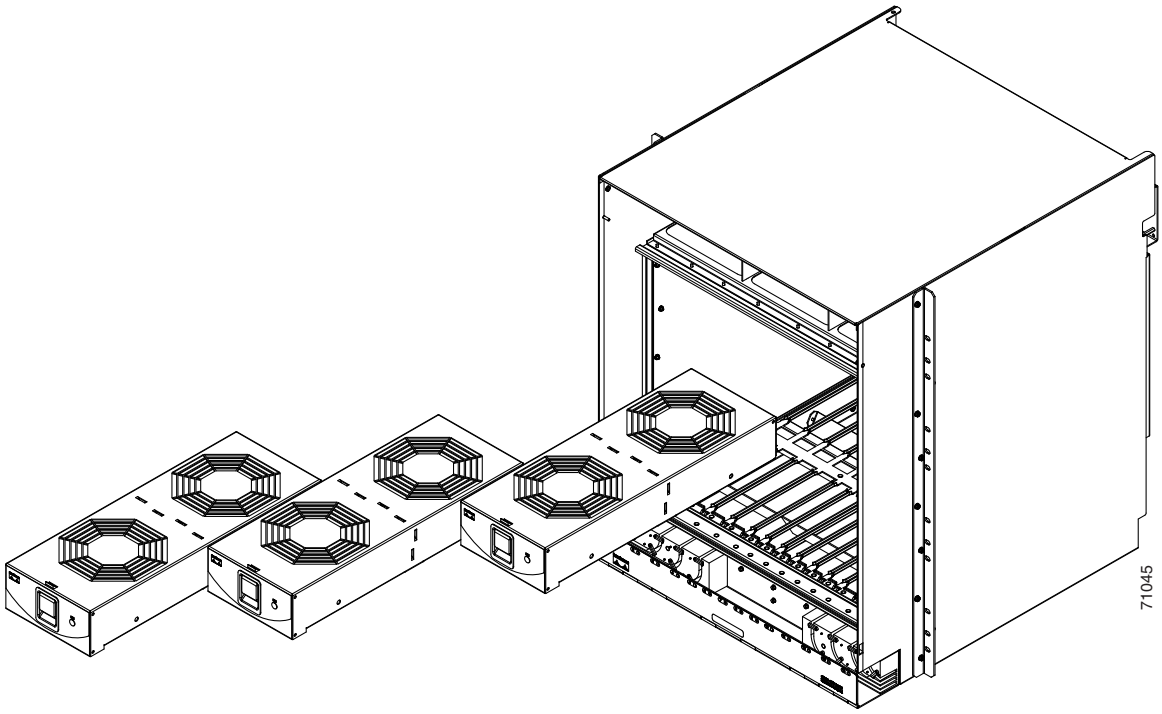
- Red wire for battery connections (–48 VDC)
- Black wire for battery return connections (0 VDC)
- The battery return connection is treated as DC-I, as defined in Telcordia GR-1089-CORE, issue 3

The ONS 15600 shelf has redundant –48 VDC power terminals on its backplane. The terminals are labeled A FEEDS and B FEEDS and are located at the top left and right sides of the shelf behind clear plastic covers.

1.10 Fan-Tray Assembly

The fan-tray assembly is located at the top of the ONS 15600 shelf front compartment. The fan-tray assembly has three removable drawers that hold two fans each and fan-control circuitry for the ONS 15600 (Figure 1-12). You should only need to access the fans if a fan fails.

Figure 1-12 Fan-Tray Assembly



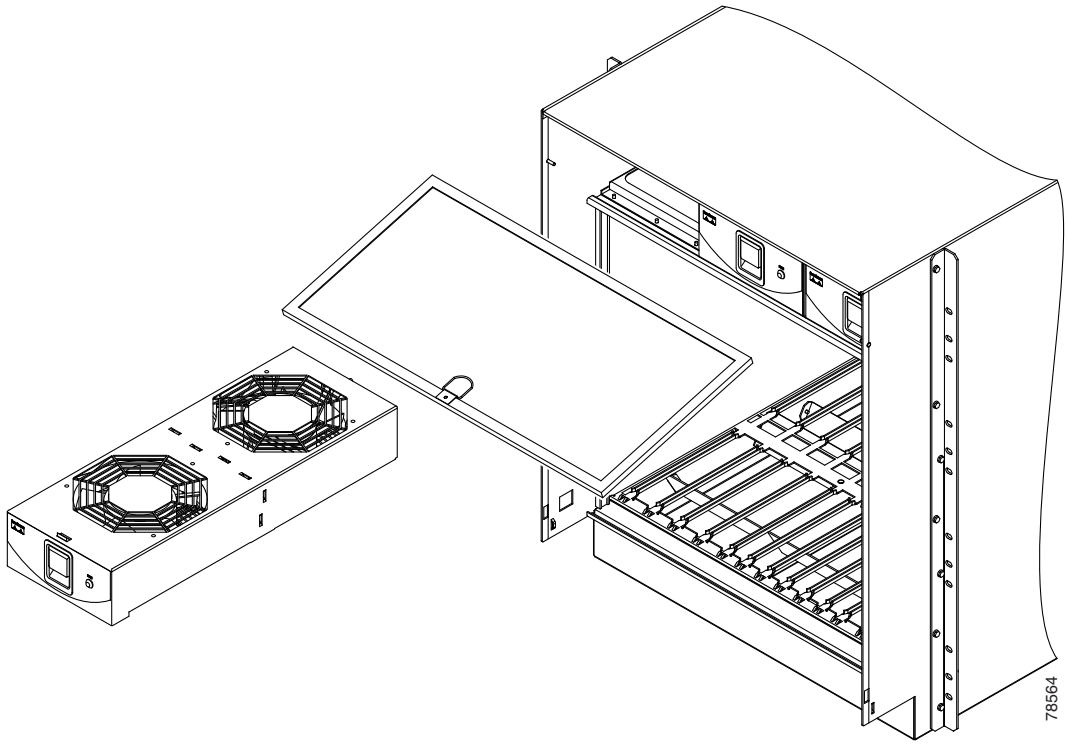
1.10.1 Air Filter

The ONS 15600 contains a reusable air filter that is made of an open-cell polyurethane foam that is flame retardant and fungi resistant. The air filter is located above the three fan trays (Figure 1-13). This disposable filter is designed to be cleaned using only mild detergents. You can order air filter replacements from Cisco Systems (P/N 700-13116-05). Keep spare filters in stock. Refer to the *Cisco ONS 15600 Procedure Guide* for information about replacing the fan-tray air filter.

Caution Inspect the air filter every 30 days, and clean the filter every three to six months. Replace the air filter every two to three years. Avoid cleaning the air filter with harsh cleaning agents or solvents.

Caution Do not operate an ONS 15600 without a fan-tray air filter. A fan-tray filter is mandatory.

Figure 1-13 Air Filter and one Fan Tray Pulled Out



1.10.2 Fan Speed and Failure

If one or more fans fail on the fan-tray assembly, replace the fan tray where that fan resides. You cannot replace individual fans. The red FAN LED on the front of the fan tray turns on when one or more fans fail. For fan-tray replacement instructions, refer to the *Cisco ONS 15600 Procedures Guide*. The red FAN LED clears after you install a working fan tray.

Caution If both fans in the center fan tray are inoperative, you must replace the fan tray within five minutes of failure to avoid affecting traffic because CTC software will shut down one of the single shelf cross-connect (SSXC) cards.

Caution The ONS 15600 requires at least one working fan in each of the three fan trays. When a single fan in a tray fails, Cisco recommends replacing the tray with a fully working tray as soon as possible.

Note Each fan tray contains two fans. The FAN LED indicates if one or both fans fail in that fan tray.

Fan speed is determined by card temperature sensors that report temperature data to the active TSC card. The sensors measure the input and output air temperature for each card. Fan speed options are low, medium, and high. For example, if a card exceeds permissible operational temperature, the fan speed

increases appropriately. At initial turn-up, the default fan speed is high until the node initializes. If both TSC cards fail, the fans automatically shift to high speed. If a single TSC card fails, the active TSC card will still control the fan speed. Table 1-1 shows the power requirements for an individual fan in a fan tray.

Table 1-1 Power Requirements for an Individual Fan

Condition	Watts	Amps	BTU/Hr.
Min at 48 V (ambient temperature less than 25 degrees C)	12	0.25	41
Max at 48 V (ambient temperature greater than 25 degrees C)	46	0.95	157

1.11 Cards and Slots

When a card is inserted in a card slot, it will contact the shelf backplane but is not fully installed until the ejectors are fully closed.

1.11.1 Card Slot Requirements

The ONS 15600 shelf has 14 card slots numbered sequentially from left to right. Slots 1 to 4 and 11 to 14 are reserved for optical (OC-N) traffic cards. These slots can host any of the ONS 15600 optical cards. Slots 6/7 and 8/9 are dedicated to SSXC cards, and Slots 5 and 10 house the TSC cards. Each card is keyed to fit only in an appropriate slot for that card. Unused card slots should be occupied by a filler card (blank faceplate).

Caution Do not operate the ONS 15600 with a single TSC card or a single SSXC card installed. Always operate the shelf with one active and one redundant standby TSC card and two SSXC cards.

Shelf assembly slots have symbols indicating the type of cards that you can install in them. Each ONS 15600 card has a corresponding symbol. The symbol on the card must match the symbol on the slot.

Table 1-2 shows the slot and card symbol definitions.

Table 1-2 Slot and Card Symbols

Symbol Color/Shape	Definition
Orange/Circle	Any optical card (OC-48 and OC-192)
Purple/Square	TSC slot; only install ONS 15600 cards with a square symbol on the faceplate
Green/Cross	SSXC slot; only install ONS 15600 cards with a cross symbol on the faceplate

Refer to Chapter 2, “Card Reference,” for more information about ONS 15600 cards.

All physical connections to the optical cards are made through OGI connectors on the card faceplate. Table 1-3 lists the number of ports and the line rates for ONS 15600 optical cards.

Table 1-3 Card Ports and Line Rates

Card	Ports	Line Rate per Port
OC48/STM16 LR/LH 16 Port 1550; OC48/STM16 SR/SH 16 Port 1310	4 physical interfaces; 4 ports per interface, totalling 16 OC-48 ports per card	2488.32 Mbps (STS-48, STS-48c)
OC192/STM64 LR/LH 4 Port 1550; OC192/STM64 SR/SH 4 Port 1310	4 physical interfaces; 1 port per interface, totalling 4 OC-192 ports per card	9.95 Gbps (STS-192, STS-192c)

1.11.2 ASAP Card Cables

To allow enough clearance between ASAP card cables and the front door on ONS 15600 shelf assembly, you must install LC connectors with a connector boot angled downward at 45 or 50 degrees.

Figure 1-14 shows a 45-degree boot with LC connector.

Figure 1-14 Molex 45-Degree Boot with LC Connector

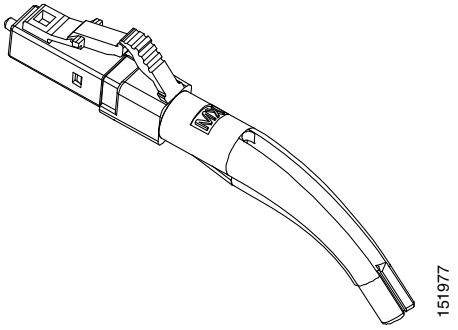
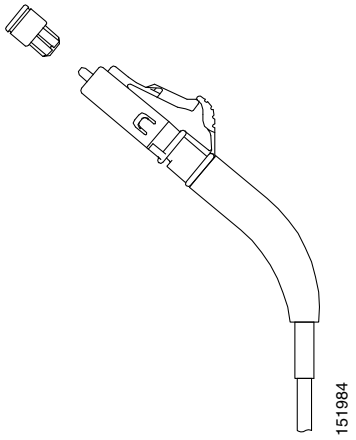


Figure 1-15 shows a 50-degree boot with LC connector.

Figure 1-15 Tyco 50-Degree Boot with LC Connector



This fiber boot should be part of your fiber-optics cable assembly, along with an LC connector.

You can obtain this boot from the following two vendor. Contact the vendor for specific part numbers:

Molex Incorporated
5224 Katrine Ave.
Downers Grove, IL 605151-800-522-6752
(630) 512-8787
(800) 213-4237

This fiber boot can also be obtained with part number from the following vendor:

Tyco Electronics (www.tycoelectronics.custhelp.com)
P.O. Box 3608
Harrisburg, PA 17175

1.11.3 OGI Cables

The ONS 15600 faceplate has OGI connectors that terminate in either SC, ST, or FC connectors. Figure 1-16 shows the OGI to SC cable breakout for the OC-48 card.

Figure 1-16 OGI Cable Breakout

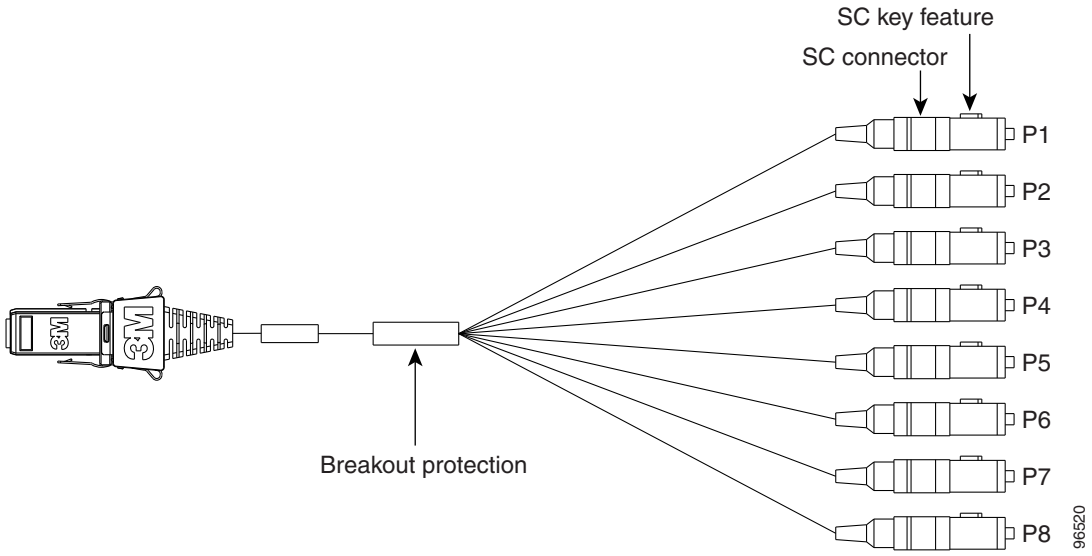
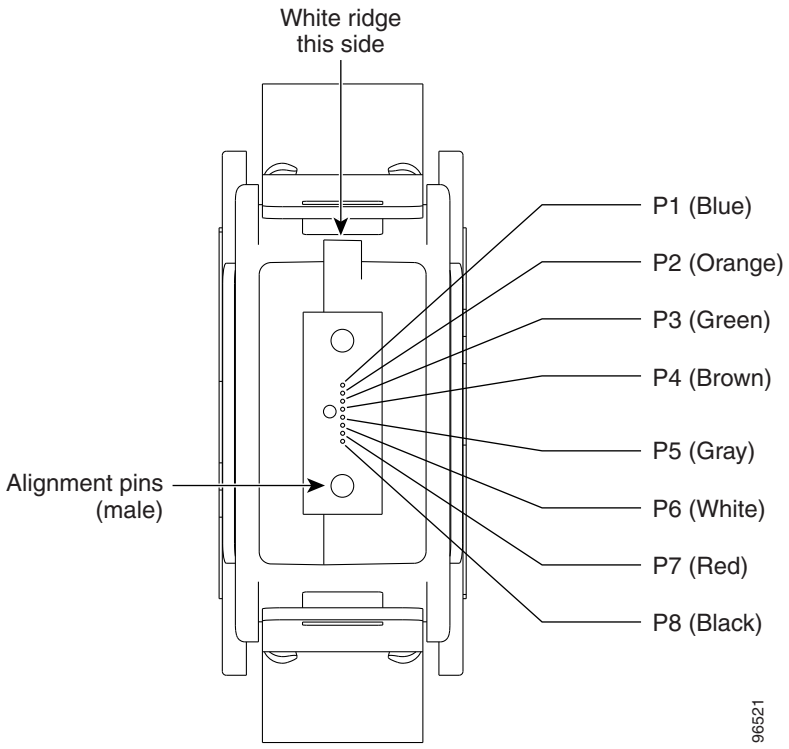


Figure 1-17 show the OGI pin breakout for the OC-48 card.

Figure 1-17 OGI Pin Breakout



1.11.4 Optical Card Cable Routing

The ONS 15600 has a cable-management tray with discrete fiber routing paths for each optical card's cables. Each fiber routing path has a plastic cable latch for securing the cables in the fiber routing path. You can rotate the cable latch into two positions, open or closed; make sure that the cable latch is always completely open before you insert or remove the optical cables. Make sure all fiber-optic cables are disconnected from a card before you remove it.

1.11.5 Card Replacement

To replace an ONS 15600 card with another card of the same type, you do not need to make any changes to the database; remove the old card and replace it with a new card. You can use the CTC Change Card feature to replace a card with a new card while maintaining all existing provisioning. To replace a card with a card of a different type, delete the original card from CTC, physically remove the card, and replace it with the new card.

Caution Removing any active/working card from the ONS 15600 can result in traffic interruption. Use caution when replacing cards and verify that only inactive or standby cards are being replaced. If the active card needs to be replaced, switch it to standby prior to removing the card from the node.

Note An improper removal (IMPROPRMVL) alarm is raised whenever a card pull is performed, unless the card is deleted in CTC first. The alarm will clear after the card replacement is complete. If the alarm does not clear, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15600 Troubleshooting Guide*.

Card Reference

This chapter describes Cisco ONS 15600 card features and functions.

Chapter topics include:

- 2.1 Card Overview, page 2-1
- 2.2 TSC Card, page 2-3
- 2.3 SSXC Card, page 2-6
- 2.4 OC48/STM16 LR/LH 16 Port 1550 Card, page 2-8
- 2.5 OC48/STM16 SR/SH 16 Port 1310 Card, page 2-11
- 2.6 OC192/STM64 LR/LH 4 Port 1550 Card, page 2-14
- 2.7 OC192/STM64 SR/SH 4 Port 1310 Card, page 2-17
- 2.8 ASAP Card, page 2-19
- 2.9 Filler Card, page 2-28
- 2.8.10 SFP Modules, page 2-25

2.1 Card Overview

Caution When working with cards, wear the supplied ESD wristband to avoid ESD damage to the card. Plug the wristband cable into the ESD jack located on the lower-left outside edge of the shelf assembly.

2.1.1 Card Summary

Table 2-1 lists the ONS 15600 cards and provides a short description of and cross-reference to each.

Table 2-1 ONS 15600 Cards and Descriptions

Card	Description	For Additional Information...
TSC	The timing and shelf controller (TSC) card performs all system-timing functions for each ONS 15600.	See the "2.2 TSC Card" section on page 2-3.
SSXC	The single shelf cross-connect card (SSXC) is the central element for ONS 15600 switching.	See the "2.3 SSXC Card" section on page 2-6

Table 2-1 ONS 15600 Cards and Descriptions (continued)

Card	Description	For Additional Information...
OC48 1550	The OC48/STM16 LR/LH 16 Port 1550 card provides 16 long-range, Telcordia GR-253-CORE compliant, SONET OC-48 ports per card.	See the "2.4 OC48/STM16 LR/LH 16 Port 1550 Card" section on page 2-8.
OC48 1310	The OC48/STM16 SR/SH 16 Port 1310 card provides 16 short-range, Telcordia GR-253-CORE compliant, SONET OC-48 ports per card.	See the "2.5 OC48/STM16 SR/SH 16 Port 1310 Card" section on page 2-11.
OC192 1550	The OC192/STM64 LR/LH 4 port 1550 card provides four long-range, Telcordia GR-253-CORE compliant, SONET OC-192 ports per card.	See the "2.6 OC192/STM64 LR/LH 4 Port 1550 Card" section on page 2-14.
OC192 1310	The OC192/STM64 SR/SH 4 Port 1310 card provides four short-range, Telcordia GR-253-CORE compliant, SONET OC-192 ports per card.	See the "2.7 OC192/STM64 SR/SH 4 Port 1310 Card" section on page 2-17.
ASAP	The Any-Service Any-Port (ASAP) card provides up to 16 Telcordia GR-253-CORE compliant, SONET OC-3, OC-12, OC-48, OC-192, or Gigabit Ethernet ports per card, with certain limitations on line rate combinations.	See the "2.8 ASAP Card" section on page 2-19.
Filler	The filler card is used to fill unused optical (OC-N) traffic card slots in the ONS 15600 shelf.	See the "2.9 Filler Card" section on page 2-28.

2.1.2 Card Compatibility

Table 2-2 lists Cisco Transport Controller (CTC) software release compatibility for each card. In Table 2-2, "Yes" means the cards are compatible with the listed software versions. Table cells with dashes mean cards are not compatible with the listed software versions.

Table 2-2 ONS 15600 Software Release Compatibility Per Card

Card	R1.0	R1.x.x	R5.0	R6.0	R7.0	R7.2
TSC	Yes	Yes	Yes	Yes	Yes	Yes
CXC	Yes	Yes	—	—	—	—
SSXC	—	—	Yes	Yes	Yes	Yes
OC48/STM16 LR/LH 16 Port 1550	Yes	Yes	Yes	Yes	Yes	Yes
OC48/STM16 SR/SH 16 Port 1310	—	Yes	Yes	Yes	Yes	Yes
OC192/STM64 LR/LH 4 Port 1550	Yes	Yes	Yes	Yes	Yes	Yes
OC192/STM64 SR/SH 4 Port 1310	—	Yes	Yes	Yes	Yes	Yes
ASAP	—	—	Yes[1]	Yes	Yes	Yes

1. ASAP card is compatible with the R5.xx maintenance release

2.2 TSC Card

Note For hardware specifications, see the "A.2.1 TSC Card Specifications" section on page A-5.

Caution Do not operate the ONS 15600 with an unprotected, single TSC card or a single SSXC card installed. Always operate the shelf with one active card and one protect card for each of these control cards.

The TSC card performs all system-timing functions for each ONS 15600. The TSC card monitors the recovered clocks from each traffic card and two building integrated timing supply (BITS) interfaces for frequency accuracy. The TSC card is provisionable, allowing timing from any optical interface source, a BITS input source, or the internal Stratum 3E as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. If you specify external timing references, your options are BITS1, BITS2, and the internal Stratum 3E sources. If you select line timing, you can specify up to two line ports from which to derive timing, as well as the internal stratum 3E sources. The TSC card also supports BITS OUT. A slow-reference tracking loop allows the TSC to synchronize with the recovered clock and enables holdover if the reference is lost.

The TSC card also provides shelf control related functions. The TSC card has a 100-Mbps Ethernet link to each card on the shelf and monitors the presence of these cards. The TSC provides bulk memory for nonvolatile storage of system software and data and provides EIA-TIA 232 and Ethernet customer interfaces. The TSC card processes and routes line and section DCC traffic as well as routing the K1, K2, and K3 overhead bytes between traffic (line) cards and SSXC cards. The TSC card controls and monitors the shelf fans and all of the alarm interfaces.

2.2.1 TSC Slots and Connectors

Install TSC cards in Slots 5 and 10 for redundancy. If the active TSC card fails, timing reference and control function switches to the protect TSC card.

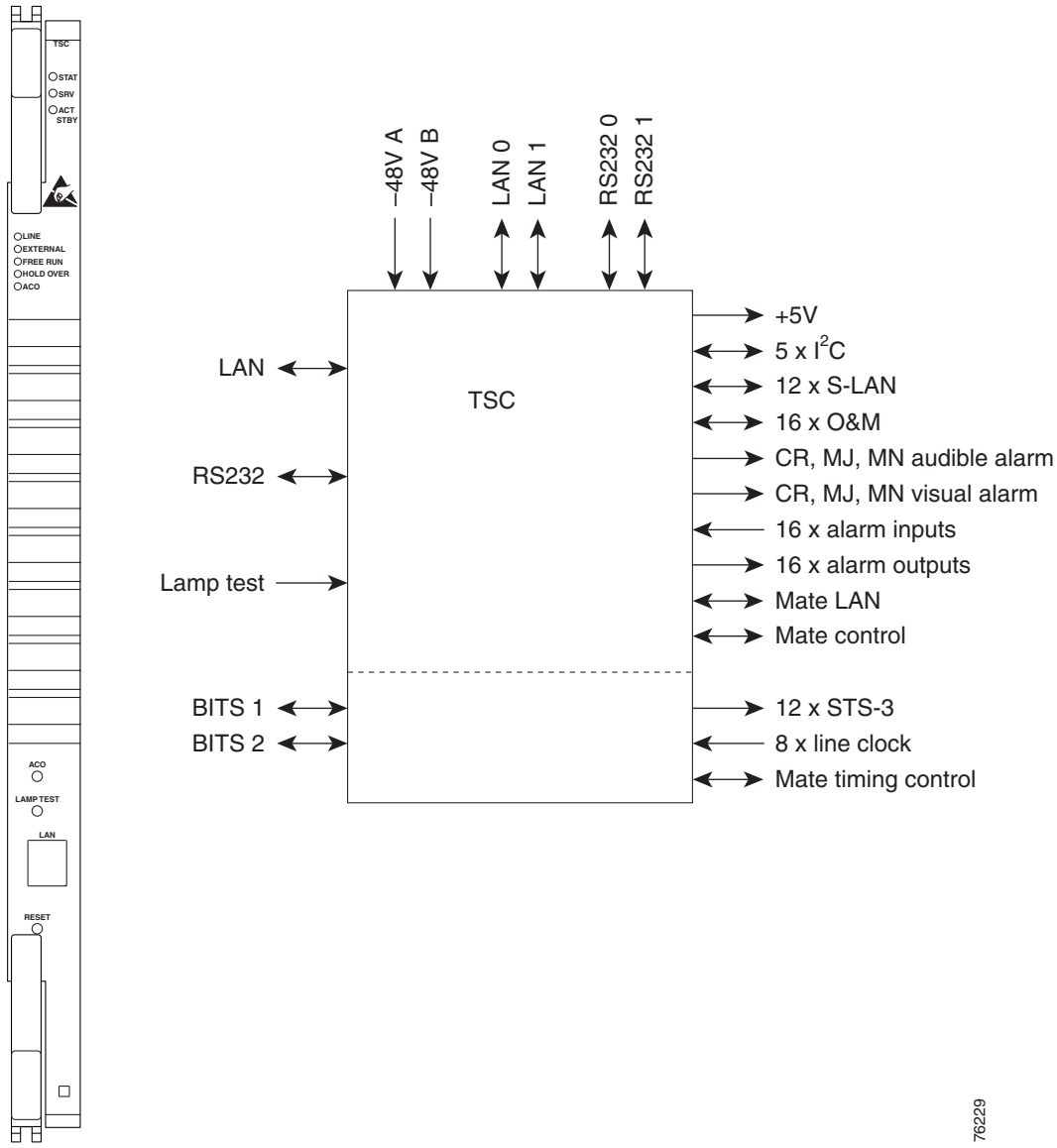
Note All TSC card protection switches conform to the Telcordia protection switching standard of equal to or less than 50 ms.

The TSC card has an RJ-45 10/100 Base-T LAN port on the faceplate. Two additional RJ-45 10/100 Base-T LAN ports and two RS-232 DB-9 type craft user interfaces are available via the Customer Access Panel (CAP) on the backplane.

2.2.2 TSC Faceplate and Block Diagram

Figure 2-1 shows the TSC card faceplate and a block diagram of the card.

Figure 2-1 TSC Card Faceplate and Block Diagram



2.2.3 TSC Card-Level Indicators

Table 2-3 describes the functions of the card-level LEDs on the TSC card faceplate.

Table 2-3 TSC Card-Level Indicators

Indicator	Color	Definition
STAT	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the card if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV	Green	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
ACT/STBY	Green	The ACT/STBY (Active/Standby) LED indicates that the TSC is active (green) or standby (off).

2.2.4 TSC Network-Level Indicators

Table 2-4 describes the functions of the network-level LEDs on the TSC card faceplate.

Table 2-4 TSC Network-Level Indicators

Indicator	Color	Definition
LINE	Green	Node timing is synchronized to a line timing reference.
EXTERNAL	Green	Node timing is synchronized to an external timing reference.
FREE RUN	Green	Node is not using an external timing reference. Indicated when the timing mode is set to an internal reference or after all external references are lost.
HOLDOVER	Amber	External/line timing references have failed. The TSC has switched to internal timing and the 24-hour holdover period has not elapsed.
ACO	Amber	The alarm cutoff (ACO) push button has been activated. After pressing the ACO button, the amber ACO LED turns on. The ACO button opens the audible closure on the backplane. The ACO state is stopped if a new alarm occurs. After the originating alarm is cleared, the ACO LED and audible alarm control are reset.

2.2.5 TSC Push-Button Switches

Table 2-5 describes the functions of the push-button switches on the TSC card faceplate.

Table 2-5 TSC Card Push-Button Switches

Push-Button	Function
ACO	Extinguishes external audible (environmental) alarms. When this button is activated, the amber-colored ACO LED turns on.
LAMP TEST	Verifies that all the LEDs in the shelf are functioning properly. When this button is activated, all of the front-panel LEDs in the shelf turn on temporarily to verify operation.
RESET	Activates a soft reset of all of the main processor memory on the card. **Note** The RESET button is recessed to prevent accidental activation.

2.3 SSXC Card

Note For hardware specifications, see the "A.2.2 SSXC Specifications" section on page A-6.

The SSXC is the central element for ONS 15600 switching. The SSXC card establishes connections and performs time division switching (TDS) at STS-1 and STS-Nc levels between ONS 15600 traffic cards.

The SSXC card works with the TSC card to maintain connections and set up cross-connects within the ONS 15600. You establish cross-connect and provisioning information using CTC or TL1. The TSC card stores the proper internal cross-connect information and relays the setup information to the SSXC card.

2.3.1 SSXC Switch Matrix

The switch matrix on each SSXC card consists of 6,144 bidirectional STS-1 ports, with a maximum of 6,144 bidirectional STS-1 cross-connections. When creating bidirectional STS-1 cross-connects, each bidirectional cross-connect uses two STS-1 ports, with the result that the SSXC card supports 3,072 bidirectional STS-1 cross-connects. Any STS-1 on any port can be connected to any other port, meaning that the STS cross-connections are nonblocking. Nonblocking connections allow network operators to connect any STS-1, STS-3, STS-12, STS-24, STS-48, or STS-192 payload that is received on an OC-48 or OC-192 interface (or additionally any STS-6 and/or STS-9 payload that is received on an ASAP interface) to any other interface capable of supporting the bandwidth.

The SSXC card has 128 input ports and 128 output ports capable of STS-48. An STS-1 on any of the input ports can be mapped to an STS-1 output port, thus providing full STS-1 time slot assignments (TSAs).

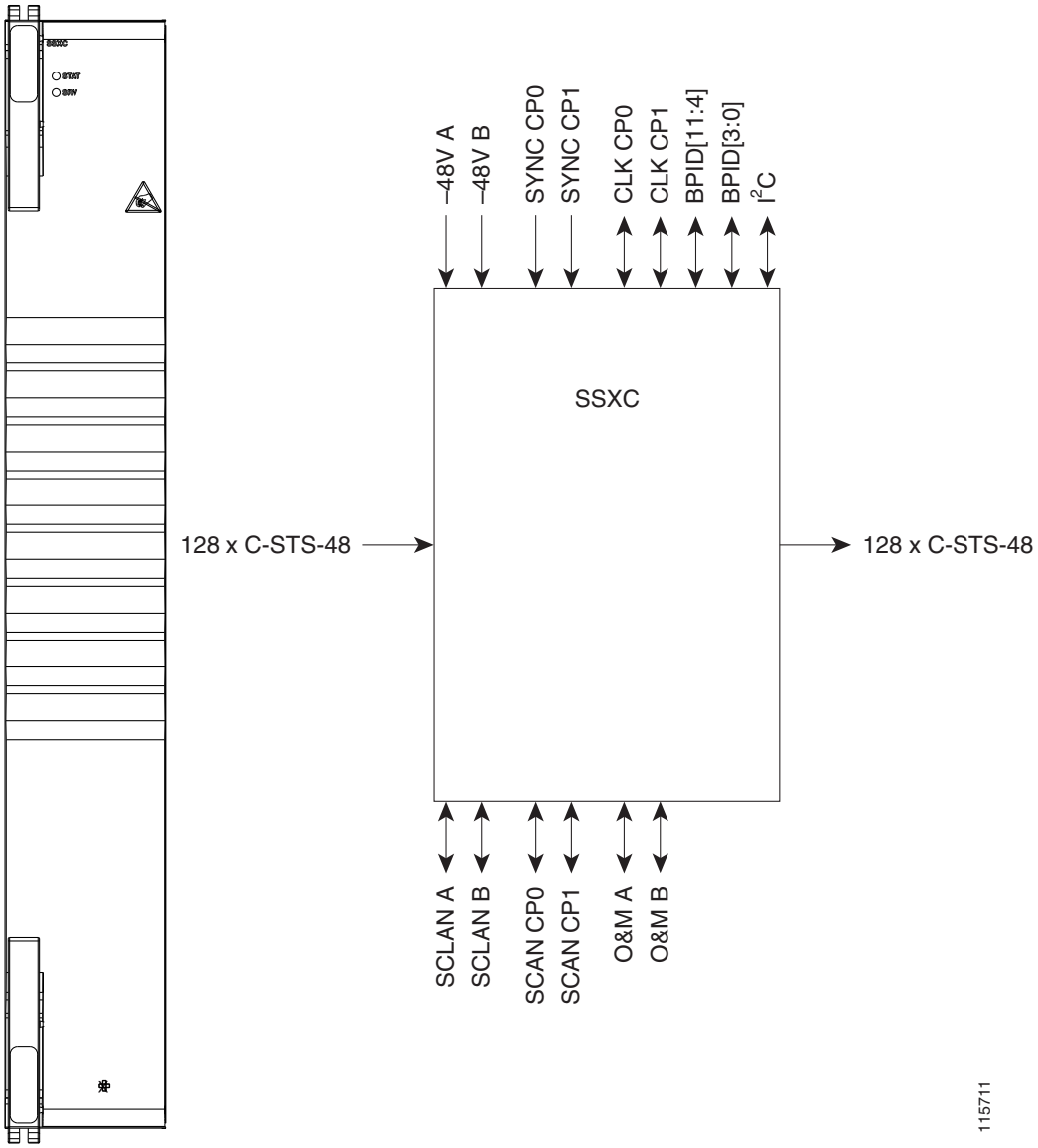
2.3.2 SSXC Slots and Connectors

Install an SSXC card in Slot 6 and a second SSXC card in Slot 8 for redundancy. (Slots 7 and 9 are also occupied by the SSXC faceplates.) The SSXC card has no external interfaces. All SSXC card interfaces are provided on the ONS 15600 backplane.

2.3.3 SSXC Faceplate and Block Diagram

Figure 2-2 shows the SSXC card faceplate and a block diagram of the card.

Figure 2-2 SSXC Card Faceplate and Block Diagram



2.3.4 SSXC Card-Level Indicators

Table 2-6 describes the functions of the card-level LEDs on the SSXC card faceplate.

Table 2-6 SSXC Card-Level Indicators

Indicator	Color	Definition
STAT	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the card if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV	Green	The service mode of the card. Green indicates the card is in use; off indicates that the card can be removed for service.
	Amber	The service mode of the card. Amber indicates the card is in use; off indicates that the card can be removed for service.

2.4 OC48/STM16 LR/LH 16 Port 1550 Card

Note For card specifications, see the "A.2.3 OC48/STM16 LR/LH 16 Port 1550 Specifications" section on page A-6.

The OC48/STM16 LR/LH 16 Port 1550 card provides 16 long-range, Telcordia GR-253-CORE compliant, SONET OC-48 ports per card. The ports operate at 2488.320 Mbps over a single-mode fiber span. The OC48/STM16 LR/LH 16 Port 1550 card has four physical connector adapters with eight fibers per connector adapter. The card supports STS-1 payloads and concatenated payloads at STS-3c, STS-12c, STS-24c, or STS-48c signal levels.

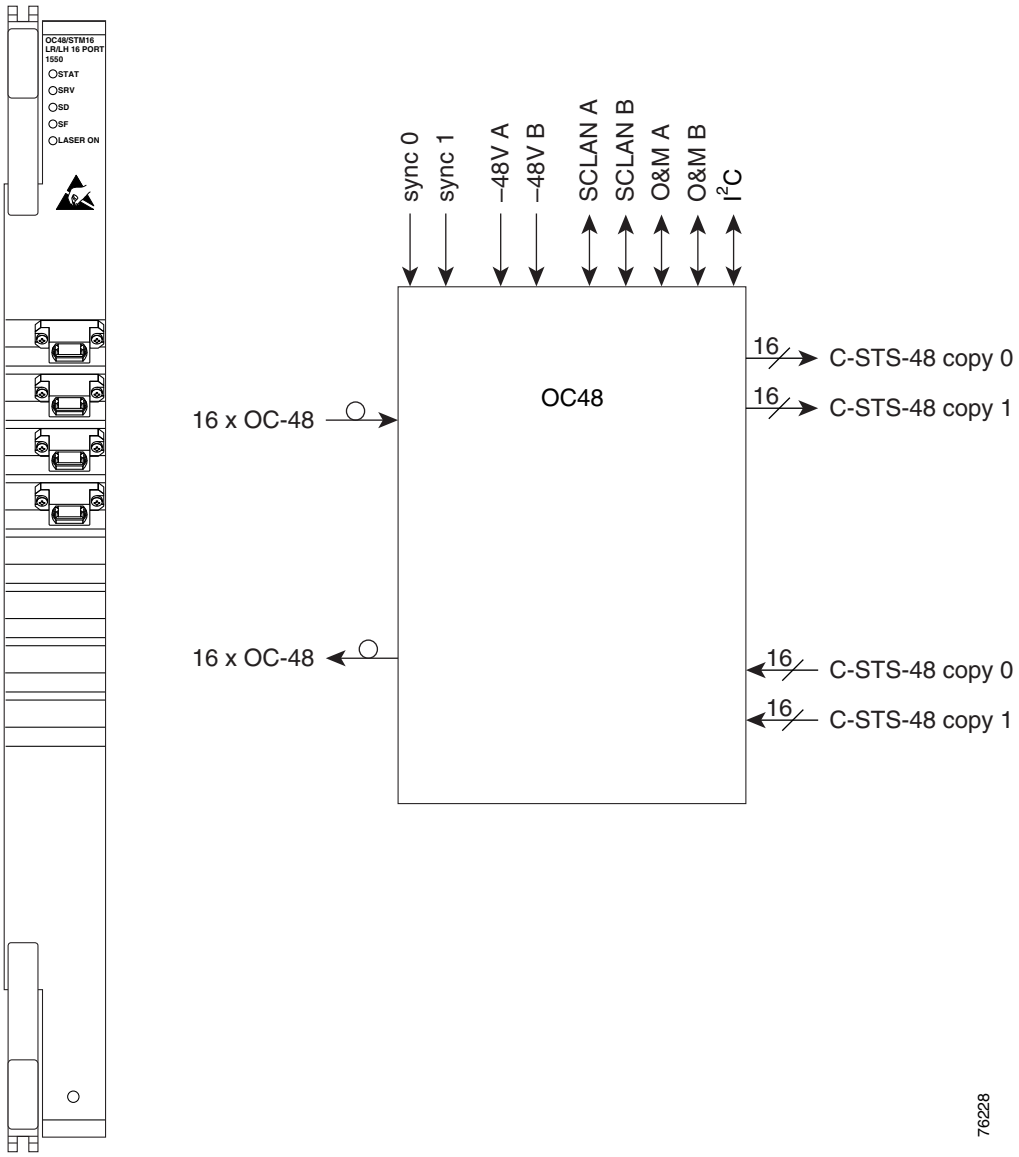
2.4.1 OC48/STM16 LR/LH 16 Port 1550 Slots and Connectors

You can install OC48/STM16 LR/LH 16 Port 1550 cards in Slots 1 through 4 and 11 through 14. The card provides four bidirectional OGI-type connector adapters on the faceplate (angled downward), each carrying eight fiber strands (four transmit and four receive).

2.4.2 OC48/STM16 LR/LH 16 Port 1550 Faceplate and Block Diagram

Figure 2-3 shows the OC48/STM16 LR/LH 16 Port 1550 faceplate and a block diagram of the card.

Figure 2-3 OC48/STM16 LR/LH 16 Port 1550 Faceplate and Block Diagram



2.4.3 OC48/STM16 LR/LH 16 Port 1550 Card-Level Indicators

Table 2-7 describes the functions of the card-level LEDs on the OC48/STM16 LR/LH 16 Port 1550 card.

Table 2-7 OC48/STM16 LR/LH 16 Port 1550 Card-Level Indicators

Indicator	Color	Description
STAT LED	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the card if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV LED	Green	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
LASER ON	Green	The green LASER ON LED indicates that at least one of the card's lasers is active.

2.4.4 OC48/STM16 LR/LH 16 Port 1550 Network-Level Indicators

Table 2-8 describes the functions of the network-level LEDs on the OC48/STM16 LR/LH 16 Port 1550 card.

Table 2-8 OC48/STM16 LR/LH 16 Port 1550 Network-Level Indicators

Indicator	Color	Description
SD LED	Blue	The blue SD LED indicates a signal degrade (SD) or condition such as a low level signal on at least one of the card's ports.
SF LED	Red	The red SF LED indicates a signal failure (SF) or condition such as loss of signal (LOS), loss of frame alignment (LOF), or turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the LED turns off.

2.4.5 OC48/STM16 LR/LH 16 Port 1550 Card OGI Connector Pinout

Table 2-9 lists the OC48/STM16 LR/LH 16 Port 1550 card OGI connector pinouts.

Table 2-9 OC48/STM16 LR/LH 16 Port 1550 Card OGI Connector Pinout

Connector	OGI Pin and Card Port							
1	1	2	3	4	5	6	7	8
	Transmit 4	Receive 4	Transmit 3	Receive 3	Transmit 2	Receive 2	Transmit 1	Receive 1
2	1	2	3	4	5	6	7	8
	Transmit 8	Receive 8	Transmit 7	Receive 7	Transmit 6	Receive 6	Transmit 5	Receive 5
3	1	2	3	4	5	6	7	8
	Transmit 12	Receive 12	Transmit 11	Receive 11	Transmit 10	Receive 10	Transmit 9	Receive 9

Table 2-9 OC48/STM16 LR/LH 16 Port 1550 Card OGI Connector Pinout (continued)

Connector	OGI Pin and Card Port							
4	1	2	3	4	5	6	7	8
	Transmit 16	Receive 16	Transmit 15	Receive 15	Transmit 14	Receive 14	Transmit 13	Receive 13

2.5 OC48/STM16 SR/SH 16 Port 1310 Card

Note For card specifications, see the "A.2.4 OC48/STM16 SR/SH 16 Port 1310 Specifications" section on page A-8.

The OC48/STM16 SR/SH 16 Port 1310 card provides 16 short-range, Telcordia GR-253-CORE compliant, SONET OC-48 ports per card. The ports operate at 2488.320 Mbps over a single-mode fiber span. The OC48/STM16 SR/SH 16 Port 1310 card has four physical connector adapters with eight fibers per connector adapter. The card supports STS-1 payloads and concatenated payloads at STS-3c, STS-12c, STS-24c, or STS-48c signal levels.

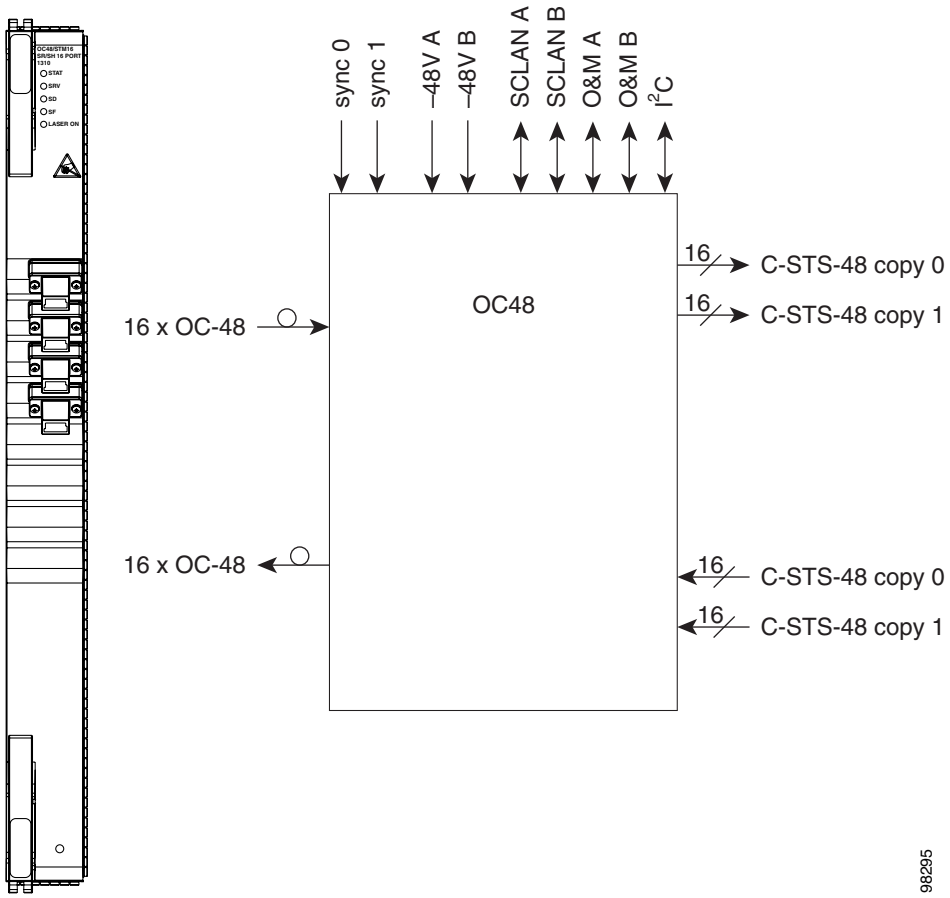
2.5.1 OC48/STM16 SR/SH 16 Port 1310 Slots and Connectors

You can install OC48/STM16 SR/SH 16 Port 1310 cards in Slots 1 through 4 and 11 through 14. The card provides four bidirectional OGI-type connector adapters on the faceplate (angled downward), each carrying eight fiber strands (four transmit and four receive).

2.5.2 OC48/STM16 SR/SH 16 Port 1310 Faceplate and Block Diagram

Figure 2-4 shows the OC48/STM16 SR/SH 16 Port 1310 faceplate and block diagram.

Figure 2-4 OC48/STM16 SR/SH 16 Port 1310 Faceplate and Block Diagram



2.5.3 OC48/STM16 SR/SH 16 Port 1310 Card-Level Indicators

Table 2-10 describes the functions of the card-level LEDs on the OC48/STM16 SR/SH 16 Port 1310 card.

Table 2-10 OC48/STM16 SR/SH 16 Port 1310 Card-Level Indicators

Indicator	Color	Description
STAT LED	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the card if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV LED	Green	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
LASER ON	Green	The green LASER ON LED indicates that at least one of the card's lasers is active.

2.5.4 OC48/STM16 SR/SH 16 Port 1310 Network-Level Indicators

Table 2-11 describes the functions of the network-level LEDs on the OC48/STM16 SR/SH 16 Port 1310 card.

Table 2-11 OC48/STM16 SR/SH 16 Port 1310 Network-Level Indicators

Indicator	Color	Description
SD LED	Blue	The blue SD LED indicates a SD or condition such as a low signal level on at least one of the card's ports.
SF LED	Red	The red SF LED indicates a signal failure or condition such as LOS, LOF, or high bit error rate (BER) on at least one of the card's ports. The red SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the LED turns off.

2.5.5 OC48/STM16 SR/SH 16 Port 1310 Card OGI Connector Pinout

Table 2-12 lists the OC48/STM16 SR/SH card OGI connector pinouts.

Table 2-12 OC48/STM16 SR/SH 16 Port 1310 Card OGI Connector Pinout

Connector	OGI Pin and Card Port							
1	1	2	3	4	5	6	7	8
	Transmit 4	Receive 4	Transmit 3	Receive 3	Transmit 2	Receive 2	Transmit 1	Receive 1
2	1	2	3	4	5	6	7	8
	Transmit 8	Receive 8	Transmit 7	Receive 7	Transmit 6	Receive 6	Transmit 5	Receive 5

Table 2-12 OC48/STM16 SR/SH 16 Port 1310 Card OGI Connector Pinout (continued)

Connector	OGI Pin and Card Port							
3	1	2	3	4	5	6	7	8
	Transmit 12	Receive 12	Transmit 11	Receive 11	Transmit 10	Receive 10	Transmit 9	Receive 9
4	1	2	3	4	5	6	7	8
	Transmit 16	Receive 16	Transmit 15	Receive 15	Transmit 14	Receive 14	Transmit 13	Receive 13

2.6 OC192/STM64 LR/LH 4 Port 1550 Card

Note For card specifications, see the "A.2.5 OC192/STM64 LR/LH 4 Port 1550 Specifications" section on page A-9.

The OC192/STM64 LR/LH 4 port 1550 card provides four long-range, Telcordia GR-253-CORE compliant, SONET OC-192 ports per card. The ports operate at 9953.28 Mbps over a single-mode fiber. The OC192/STM64 LR/LH 4 port 1550 card has four physical connector adapters with two fibers per connector adapter. The card supports STS-1 payloads and concatenated payloads at STS-3c, STS-12c, STS-24c, STS-48c, or STS-192c signal levels.

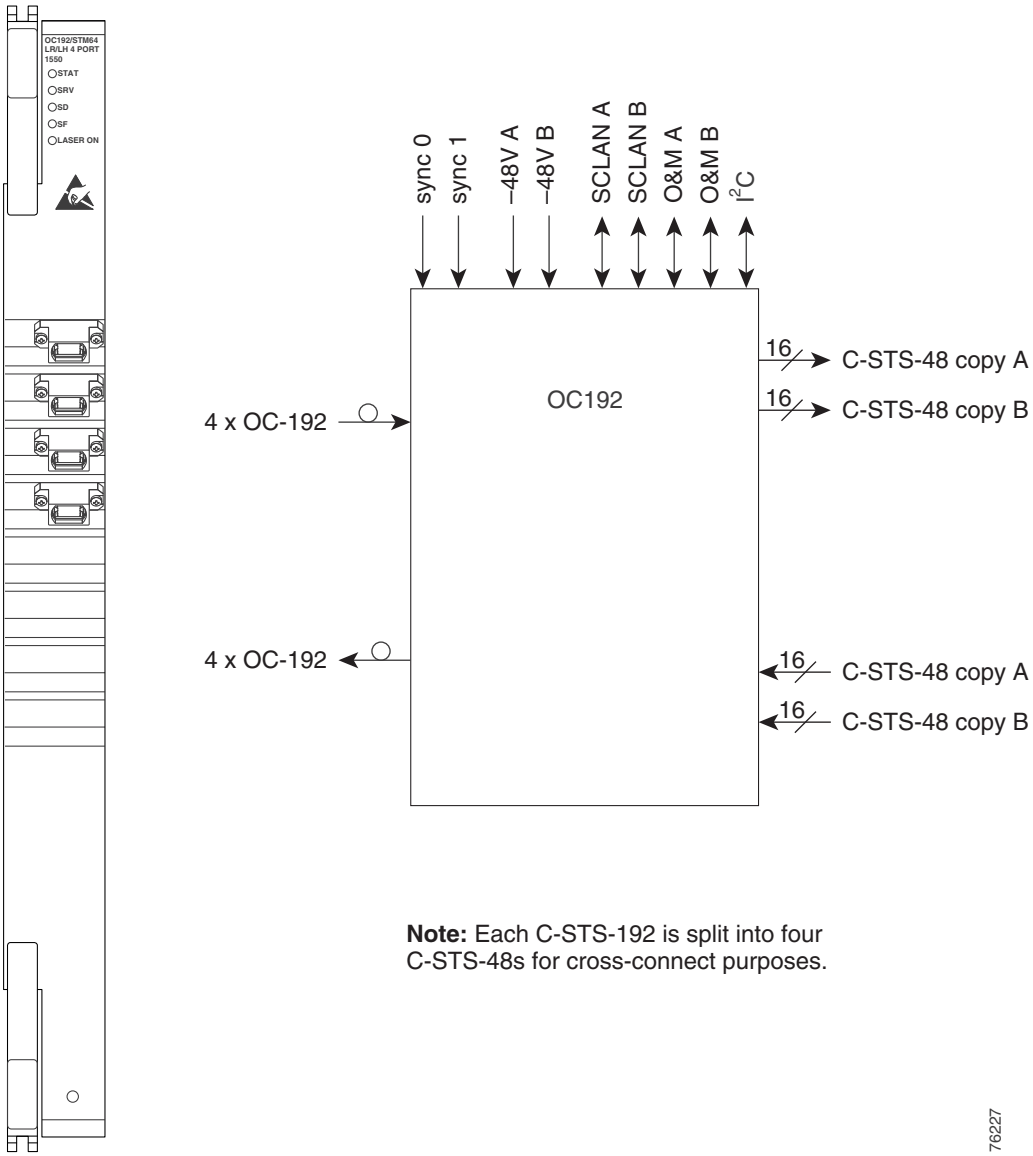
2.6.1 OC192/STM64 LR/LH 4 Port 1550 Slots and Connectors

You can install OC192/STM64 LR/LH 4 port 1550 cards in Slots 1 through 4 and 11 through 14. The card provides four bidirectional OGI-type connector adapters on the faceplate (angled downward), carrying two fiber strands (one transmit and one receive). Only one transmit and receive pair is used per connector adapter. On a breakout cable, use port three, fiber 4 (transmit) and fiber 3 (receive).

2.6.2 OC192/STM64 LR/LH 4 Port 1550 Faceplate and Block Diagram

Figure 2-5 shows the OC192/STM64 LR/LH 4 Port 1550 faceplate and a block diagram of the card.

Figure 2-5 OC192/STM64 LR/LH 4 Port 1550 Faceplate and Block Diagram



2.6.3 OC192/STM64 LR/LH 4 Port 1550 Card-Level Indicators

Table 2-13 describes the functions of the card-level LEDs on the OC192/STM64 LR/LH 4 Port 1550 card.

Table 2-13 OC192/STM64 LR/LH 4 Port 1550 Card-Level Indicators

Indicator	Color	Description
STAT LED	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the unit if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV LED	Green	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
LASER ON	Green	The green LASER ON LED indicates that at least one of the card's lasers is active.

2.6.4 OC192/STM64 LR/LH 4 Port 1550 Network-Level Indicators

Table 2-14 describes the functions of the network-level LEDs on the OC192/STM64 LR/LH 4 Port 1550 card.

Table 2-14 OC192/STM64 LR/LH 4 Port 1550 Network-Level Indicators

Indicator	Color	Description
SD LED	Blue	The blue SD LED indicates a signal degrade or condition such as a low signal level on at least one of the card's ports.
SF LED	Red	The red SF LED indicates a signal failure or condition such as LOS, LOF, or high BER on at least one of the card's ports. The red SF LED is also on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the LED turns off.

2.6.5 OC192/STM64 LR/LH 4 Port 1550 Card OGI Connector Pinout

Table 2-15 lists the OC192/STM64 LR/LH 4 Port 1550 card OGI connector pinouts.

Table 2-15 OC192/STM64 LR/LH 4 Port 1550 Card OGI Connector Pinout

Connector	OGI Pin and Card Port							
1	1	2	3	4	5	6	7	8
	—	—	Transmit 1	Receive 1	—	—	—	—
2	1	2	3	4	5	6	7	8
	—	—	Transmit 2	Receive 2	—	—	—	—
3	1	2	3	4	5	6	7	8
	—	—	Transmit 3	Receive 3	—	—	—	—

Table 2-15 OC192/STM64 LR/LH 4 Port 1550 Card OGI Connector Pinout (continued)

Connector	OGI Pin and Card Port							
4	1	2	3	4	5	6	7	8
	—	—	Transmit 4	Receive 4	—	—	—	—

2.7 OC192/STM64 SR/SH 4 Port 1310 Card

Note For card specifications, see the "A.2.6 OC192/STM64 SR/SH 4 Port 1310 Specifications" section on page A-10.

The OC192/STM64 SR/SH 4 Port 1310 card provides four short-range, Telcordia GR-253-CORE compliant, SONET OC-192 ports per card. The ports operate at 9953.28 Mbps over a single-mode fiber. The OC192/STM64 SR/SH 4 port 1310 card has four physical connector adapters with two fibers per connector adapter. The card supports STS-1 payloads and concatenated payloads at STS-3c, STS-12c, STS-24c, STS-48c, or STS-192c signal levels.

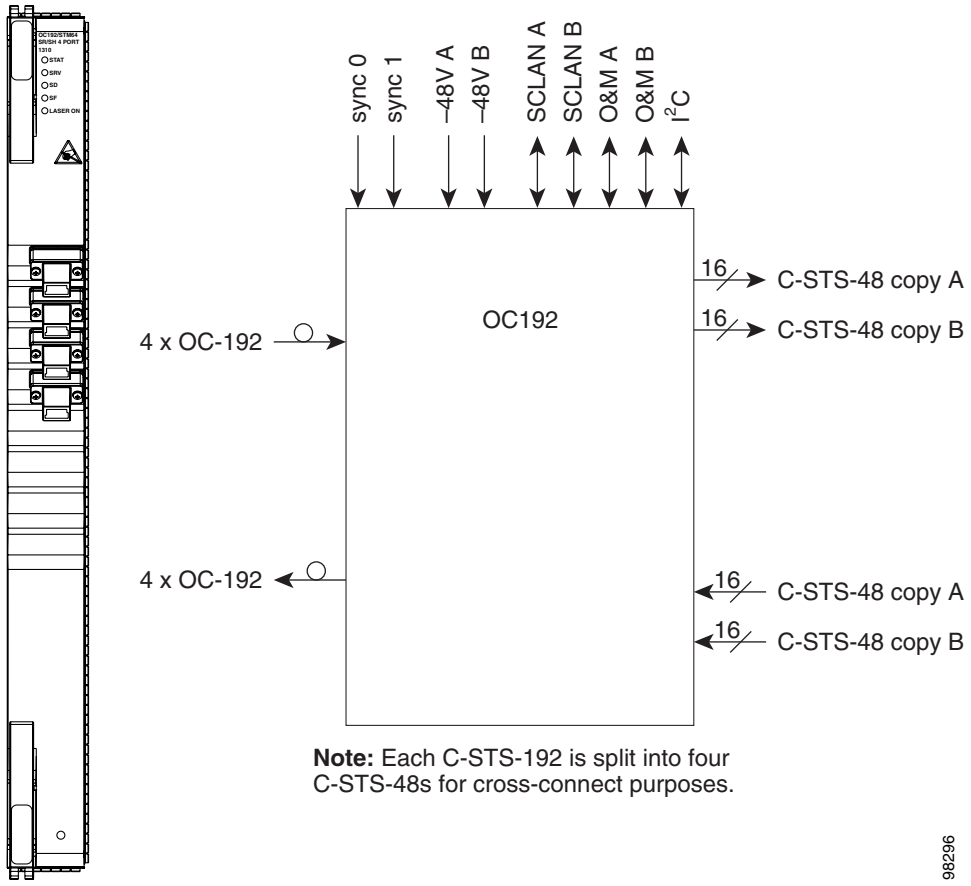
2.7.1 OC192/STM64 SR/SH 4 Port 1310 Slots and Connectors

You can install OC192/STM64 SR/SH 4 Port 1310 cards in Slots 1 through 4 and 11 through 14. The card provides four bidirectional OGI-type connector adapters on the faceplate (angled downward), carrying two fiber strands (one transmit and one receive). Only one transmit and receive pair is used per connector adapter. On a breakout cable, use port three, fiber 4 (transmit) and fiber 3 (receive).

2.7.2 OC192/STM64 SR/SH 4 Port 1310 Faceplate and Block Diagram

Figure 2-6 shows the OC192/STM64 SR/SH 4 Port 1310 faceplate and block diagram.

Figure 2-6 OC192/STM64 SR/SH 4 Port 1310 Faceplate and Block Diagram



2.7.3 OC192/STM64 SR/SH 4 Port 1310 Card-Level Indicators

Table 2-16 describes the functions of the card-level LEDs on the OC192/STM64 SR/SH 4 Port 1310 card.

Table 2-16 OC192/STM64 SR/SH 4 Port 1310 Card-Level Indicators

Indicator	Color	Description
STAT LED	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the unit if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.

Table 2-16 OC192/STM64 SR/SH 4 Port 1310 Card-Level Indicators (continued)

Indicator	Color	Description
SRV LED	Green	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
LASER ON	Green	The green LASER ON LED indicates that at least one of the card's lasers is active.

2.7.4 OC192/STM64 SR/SH 4 Port 1310 Network-Level Indicators

Table 2-17 describes the functions of the network-level LEDs on the OC192/STM64 SR/SH 4 Port 1310 card.

Table 2-17 OC192/STM64 SR/SH 4 port 1310 Network-Level Indicators

Indicator	Color	Description
SD LED	Blue	The blue SD LED indicates a signal degrade or condition such as a low signal level on at least one of the card's ports.
SF LED	Red	The red SF LED indicates a signal failure or condition such as LOS, LOF, or high BER on at least one of the card's ports. The red SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the LED turns off.

2.7.5 OC192/STM64 SR/SH 4 Port 1310 Card OGI Connector Pinout

Table 2-18 lists the OC192/STM64 SR/SH 4 Port 1310 card OGI connector pinouts.

Table 2-18 OC192/STM64 SR/SH 4 Port 1310 Card OGI Connector Pinout

Connector	OGI Pin and Card Port							
1	1	2	3	4	5	6	7	8
	—	—	Transmit 1	Receive 1	—	—	—	—
2	1	2	3	4	5	6	7	8
	—	—	Transmit 2	Receive 2	—	—	—	—
3	1	2	3	4	5	6	7	8
	—	—	Transmit 3	Receive 3	—	—	—	—
4	1	2	3	4	5	6	7	8
	—	—	Transmit 4	Receive 4	—	—	—	—

2.8 ASAP Card

Note For card specifications, see the "A.2.7 ASAP Specifications" section on page A-11.

The ASAP card provides up to 16 Telcordia GR-253-CORE compliant, SONET OC-3, OC-12, OC-48, or Gigabit Ethernet ports, or up to 4 Telcordia GR-253-CORE compliant, SONET OC-192 ports, in any combination of line rates. The ASAP card, when used with the 4-Port I/O (4PIO) module, has up to 16 physical connector adapters (known as Small Form-factor Pluggables [SFPs]). The SFP ports operate at up to 2488.320 Mbps over a single-mode fiber. The ASAP card, when used with the 1-Port I/O (1PIO) module, has up to 4 physical connector adapters (known as 10Gigabit Small Form Factor Pluggables [XFPs]). The XFP ports operate at up to 9953.280 Mbps over a single-mode fiber. Both XFP and SFP physical connector adapters have two fibers per connector adapter (transmit [Tx] and receive [Rx]). The ASAP card supports STS-1 payloads and concatenated payloads at STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c and STS-192c signal levels. The ASAP card is interoperable with ONS 15454 E-Series, G-Series, and ML-Series Ethernet cards.

Table 2-19 The following table gives a list of circuits supported by each SFP on ASAP card

SFP on ASAP	STS1	STS3c	STS6c	STS9c	STS12c	STS18c	STS24c	STS36c	STS48c	STS192c
OC3	x	x								
OC12	x	x	x	x	x					
OC48	x	x	x	x	x	x	x	x	x	
OC192	x	x	x	x	x	x	x	x	x	x

There are three major components to the ASAP card:

- Carrier card, which can be installed in Slots 1 through 4 and 11 through 14
- 4PIO and 1PIO modules, also called Pluggable Input/Output Module (PIMs), which plug into the ASAP carrier card
- SFPs/XFPs, called Pluggable Port Modules (PPMs) in CTC, which plug into the 4PIO or 1PIO (PIM) module and provide the fiber interface using a female LC connector

2.8.1 ASAP Connectors

An ASAP carrier card supports any combination of four 4PIOs or 1PIOs. Each 4PIO supports up to four SFPs, while each 1PIO supports one SFP/XFP. The maximum configuration for an ASAP card is 16 SFP or 4 XFP ports, or a mix of both. The ports can each be provisioned as either OC-3, OC-12, OC-48, OC192 (1PIO only), or Gigabit Ethernet.

In addition, the ports can be provisioned with OC-48 dense wavelength division multiplexing (DWDM) SFPs. 32 SFPs, each with separate product IDs (PIDs), allow operation on 32 channels, separated by 100 GHz on the ITU grid. The modules offer operation in the red band from 1546.12 to 1560.61 nm and in the blue band from 1530.33 to 1544.53 nm. These SFPs can be used in Metro, Regional, or Long Haul applications. Eight ASAP cards can be installed in a shelf, and up to four ITU-T SFPs can be plugged into each of the four 4PIO/PIMs (or one XFP in the 1PIO), providing a maximum of 128 ITU-T SFPs in a single shelf.

For detailed information about SFPs/XFPs, see the "2.8.10 SFP Modules" section on page 2-25. To determine the line rates supported by each SFP/XFP, see the "A.3 SFP/XFP Specifications" section on page A-12.

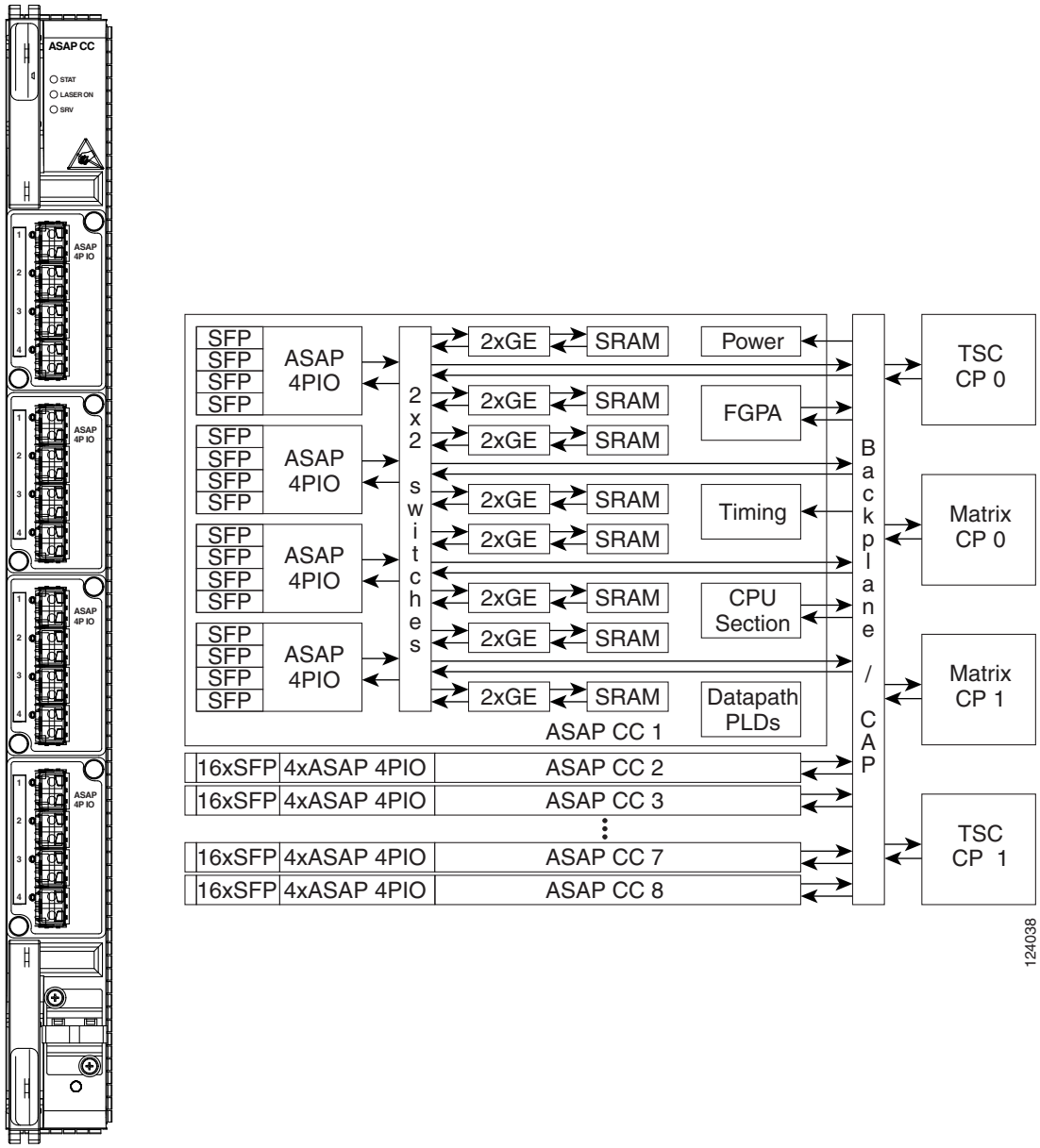
2.8.2 ASAP Covers and Plugs

The covers and plugs that are shipped with the ASAP carrier card, 4PIOs, 1PIOs, and SFPs/XFPs must be used in configurations where any of the these slots are unoccupied.

2.8.3 ASAP Card Faceplate and Block Diagram with 4PIOs Installed

Figure 2-7 shows the ASAP card faceplate, with four 4PIOs installed, and block diagram.

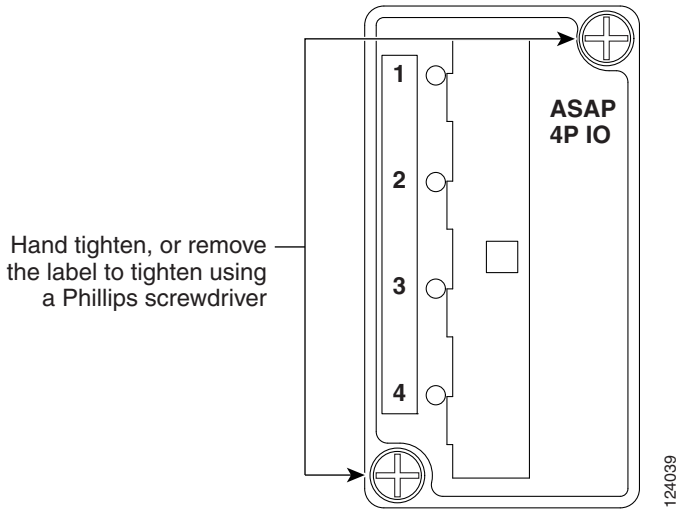
Figure 2-7 ASAP Card Faceplate and Block Diagram (4PIOs Installed)



2.8.4 4PIO Module Faceplate

Figure 2-8 shows the 4PIO module faceplate.

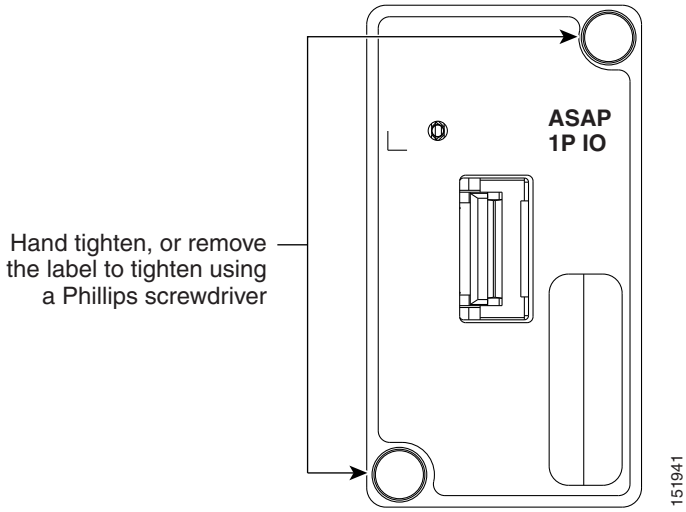
Figure 2-8 4PIO Module Faceplate



2.8.5 1PIO Module Faceplate

Figure 2-9 shows the 1PIO module faceplate.

Figure 2-9 1PIO Module Faceplate



2.8.6 ASAP Card-Level Indicators

Table 2-20 describes the functions of the card-level LEDs on the ASAP carrier module.

Table 2-20 ASAP Card-Level Indicators

Indicator	Color	Description
STAT LED	Red	Indicates a hardware fault; this LED is off during normal operation. Replace the unit if the STAT LED persists. During diagnostics, the LED flashes quickly during initialization and slowly during configuration synchronization.
SRV LED	Green/Amber	The service mode of the card. Green indicates that the card is in use, amber indicates that the card is out of service, and off indicates that the card is either booting or has no power applied.
LASER ON	Green	The green LASER ON LED indicates that at least one of the card's lasers is active.

2.8.7 ASAP Card Port-Level Indicators

Table 2-21 describes the functions of the port-level LEDs on the 4PIO and 1PIO modules, depending on whether the port is configured for SONET or Ethernet. (On the 4PIO modules, the port-level LEDs are numbered 1 through 4.)

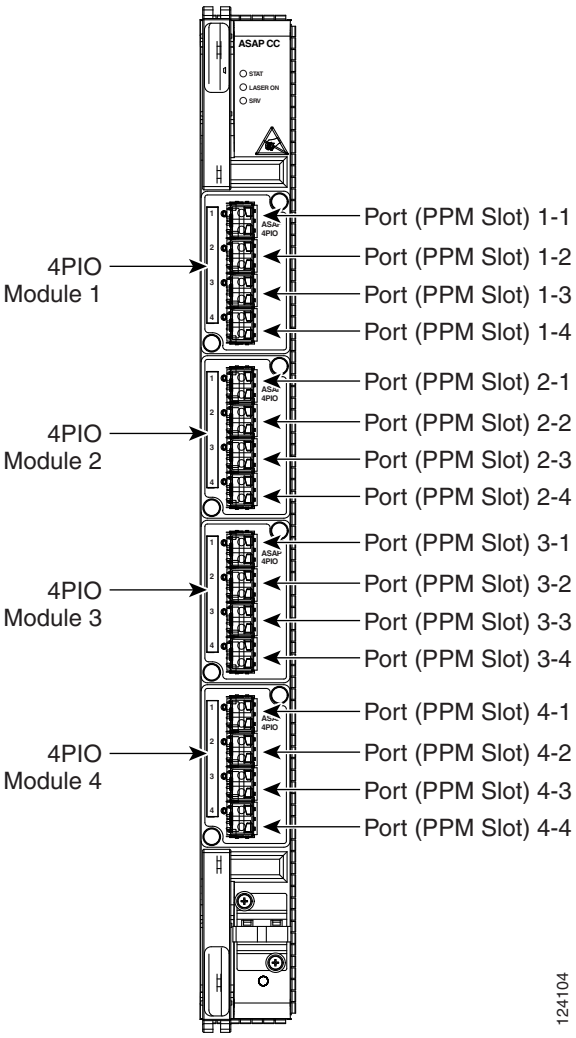
Table 2-21 ASAP (4PIO and 1PIO Module) Port-Level Indicators

Color	Description for a SONET-Configured Port	Description for an Ethernet-Configured Port
Green	Indicates that the port is provisioned.	Constant green indicates that there is a link and no traffic. Flashing green indicates that there is a link, and the LED flashes at a rate proportional to the level of traffic being received and transmitted over the port.
Amber	Indicates that the signal is degraded.	Amber indicates that the link has an issue inhibiting traffic, such as a signal error, or disabled port.
Red	Indicates a signal failure.	Indicates a signal failure.
Off	Indicates that the port is unprovisioned.	Indicates that there is no link.

2.8.8 ASAP Card Port Numbering (4PIO Installed)

Figure 2-10 shows the installed 4PIO modules and corresponding port numbers for each SFP slot.

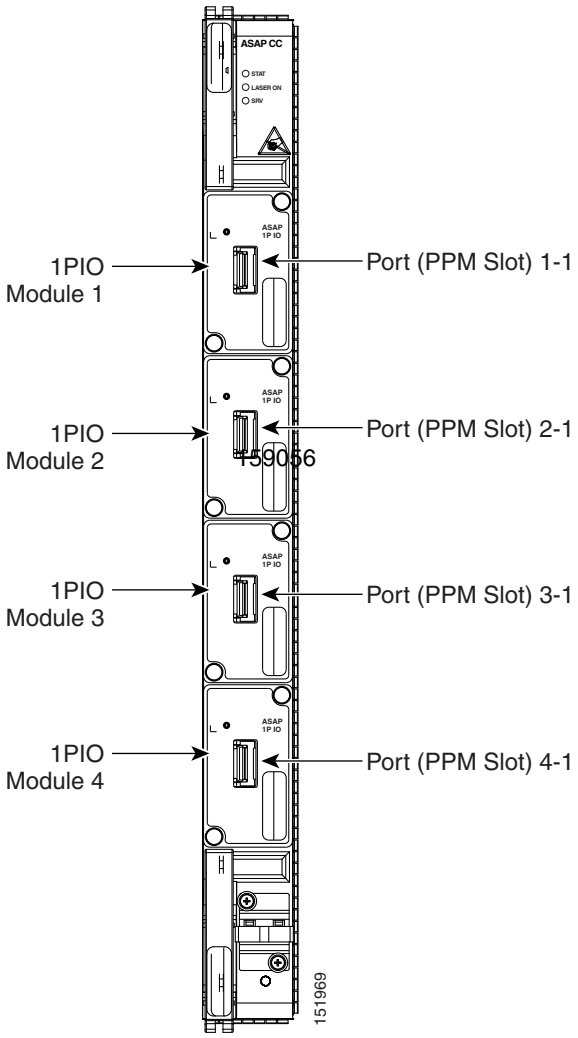
Figure 2-10 ASAP 4PIO Port Numbering



2.8.9 ASAP Card Port Numbering (1PIO Installed)

Figure 2-11 shows the installed 1PIO modules and corresponding port numbers for each XFP slot.

Figure 2-11 ASAP 1PIO Port Numbering



2.8.10 SFP Modules

This section describes the SFPs that provide the fiber interface to the ONS 15600 ASAP card when used with the 4PIO modules. A line rate (OC-3, OC-12, OC-48, or Gigabit Ethernet) must be assigned to each SFP in the CTC software interface or using TL1. In CTC, SFPs are known as pluggable port modules (PPMs). To provision PPMs, refer to the *Cisco ONS 15600 Procedure Guide*.

Note For information about XFPs, which allow you to provision an OC-192 line rate when used with the 1PIO module, see the "2.8.11 XFP Description" section on page 2-27.

Table 2-22 lists the SFPs (PPMs) that are compatible with the ASAP card.

Caution Use only SFPs certified for use in Cisco Optical Networking Systems. The qualified Cisco SFP pluggable module's top assembly numbers (TANs) are provided in Table 2-22.

Table 2-22 SFP Compatibility

Card	Compatible SFP (Cisco Product ID)	Cisco Top Assembly Number (TAN)
ASAP 4PIO only (ONS 15600 SONET/SDH)	ONS-SE-2G-L2	10-2013-01
	ONS-SE-Z1	10-1971-01
	ONS-SI-622-L2	10-1936-01
	ONS-SI-155-L2	10-1937-01
	ONS-SC-2G-46.1 through 60.6	10-2170-01 through 10-2184-01, and 10-2186-01
	ONS-SC-2G-30.3 through 44.5	10-2155-01 through 10-2169-01, and 10-2185-01

To determine the line rates supported by each SFP/XFP, see the "A.3 SFP/XFP Specifications" section on page A-12.

SFPs are integrated fiber optic transceivers that provide high-speed serial links from a port or slot to the network. Various latching mechanisms can be used on the SFP/XFP modules. There is no correlation between the type of latch and the model type (such as SX or LX/LH) or technology type (such as Gigabit Ethernet). See the label on the SFP/XFP for technology type and model. One type of latch available is a Mylar tab as shown in Figure 2-12, a second type of latch available is an actuator/button (Figure 2-13), and a third type of latch is a bail clasp (Figure 2-14).

SFP dimensions are:

- Height 0.03 in. (8.5 mm)
- Width 0.53 in. (13.4 mm)
- Depth 2.22 in. (56.5 mm)

SFP temperature ranges for are:

- COM—Commercial operating temperature range –5 to 70 degrees C
- EXT—Extended operating temperature range –5 to 85 degrees C
- IND—Industrial operating temperature range –40 to 85 degrees C

Figure 2-12 Mylar Tab SFP

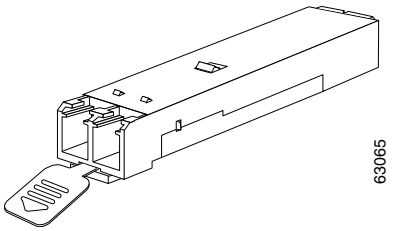


Figure 2-13 Actuator/Button SFP

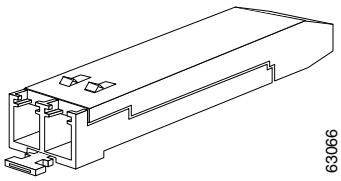
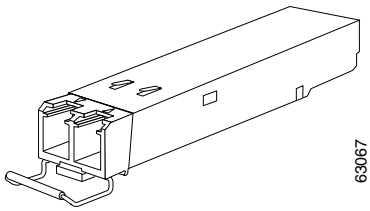


Figure 2-14 Bail Clasp SFP



2.8.11 XFP Description

The 10-Gbps 1310-nm and 1550-nm XFP transceivers are integrated fiber optic transceivers that provide high-speed serial links at the following signaling rates: 9.95 Gbps, 10.31 Gbps, and 10.52 Gbps. The XFP integrates both the receiver and transmit path. The transmit side recovers and retimes the 10-Gbps serial data and passes it to a laser driver. The laser driver biases and modulates single mode (SMF) optical interfaces at 1310-nm or 1550-nm. The modules support all data encodings through an LC connector. The receive side recovers, retimes the 10-Gbps optical data stream from a positive-intrinsic-negative (PIN) photodetector, transimpedance amplifier and passes it to an output driver.

Caution Use only XFPs certified for use in Cisco Optical Networking Systems. The qualified Cisco XFP pluggable module's top assembly numbers (TANs) are provided in Table 2-23.

Table 2-23 XFP Compatibility

Card	Compatible XFP (Cisco Product ID)	Cisco Top Assembly Number (TAN)
ASAP 1PIO only (ONS 15600 SONET/SDH)	ONS-XC-10G-S1 ONS-XC-10G-L2	10-2112-01 10-2194-01

The XFP module uses the bail clasp latching mechanism, shown unlatched in Figure 2-15 and latched in Figure 2-16. See the label on the XFP for technology type and model.

Figure 2-15 Bail Clasp XFP (Unlatched)

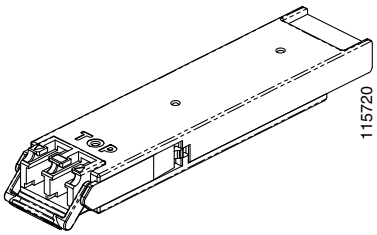
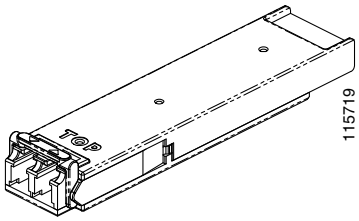


Figure 2-16 Bail Clasp XFP (Latched)



XFP dimensions are:

- Height 0.33 in. (8.5 mm)
- Width 0.72 in. (18.3 mm)
- Depth 3.1 in. (78 mm)

XFP temperature ranges are:

- COM—Commercial operating temperature range: 23 to 158 degrees Fahrenheit (–5 to 70 degrees Celsius)
- EXT—Extended operating temperature range: 23 to185 degrees Fahrenheit (–5to 85 degrees Celsius)
- IND—Industrial operating temperature range: –40 to 185 degrees Fahrenheit (–40 to 85 degrees Celsius)

2.8.12 PPM Provisioning

SFPs and XFPs are known as pluggable-port modules (PPMs) in the CTC. Multirate PPMs for the ASAP card can be provisioned for different line rates in CTC. For more information about provisioning PPMs, refer to the *Cisco ONS 15600 Procedure Guide*.

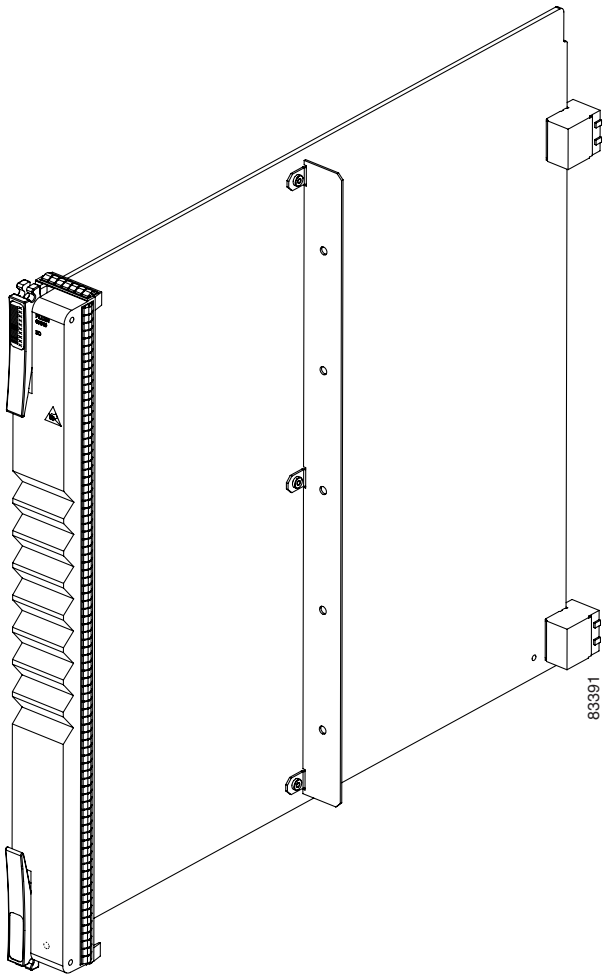
2.9 Filler Card

Note For card specifications, see the "A.2.8 Filler Card Specifications" section on page A-12.

The Filler card is used to fill unused optical (OC-N) traffic card slots in the ONS 15600 shelf. In Software Release 1.1 and later, the Filler card has a card presence indicator (CPI) that allows the shelf to report the presence of the filler card to CTC. The Filler card uses dummy backplane connectors and a standard faceplate to secure the card in the empty shelf slot.

Figure 2-17 shows the Filler card body and faceplate.

Figure 2-17 ONS 15600 Filler Card



Card Protection

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter explains the Cisco ONS 15600 card protection configurations.

Chapter topics include:

- 3.1 Optical Port Protection, page 3-1
- 3.2 Unprotected Ports, page 3-3
- 3.3 External Switching Commands, page 3-3

3.1 Optical Port Protection

When you set up protection for ONS 15600 cards, you must choose between maximum protection and maximum port availability. The highest protection reduces the number of available ports; the highest port availability reduces the protection. Table 3-1 contrasts port protection with an unprotected scheme.

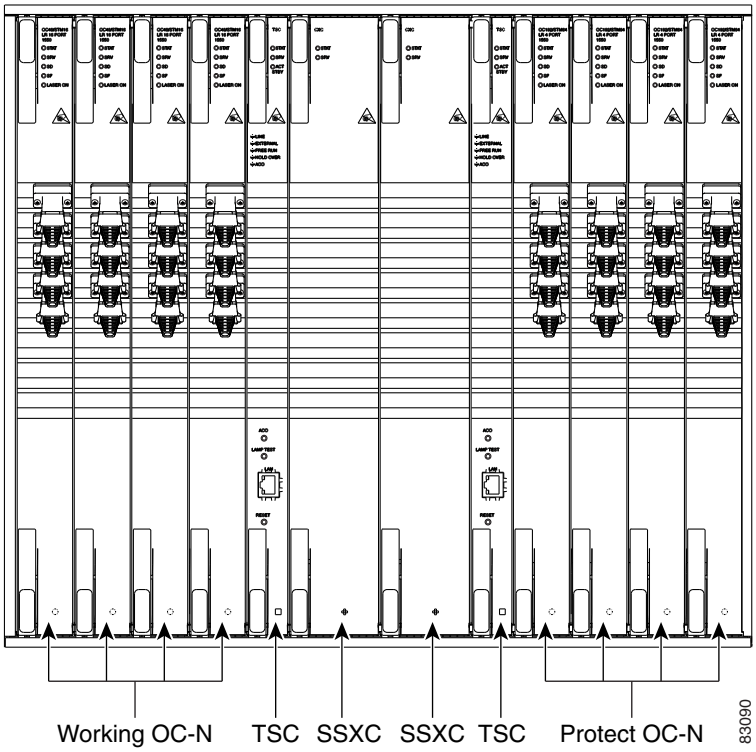
Table 3-1 Port Protection Types

Type	Ports	Description
1+1	Any optical	Pairs a working optical port with a protect optical port. Protect ports must match the line rate of the working ports. For example, Port 1 of an OC-48 card can only be protected by another OC-48 port. Ports do not need to be in adjoining slots. For maximum protection, provision the ports/cards in Slots 1 to 4 as working and the ports/cards in Slots 11 to 14 as protect.
Unprotected	Any	Unprotected ports can cause traffic loss if a port fails or incurs a signal error. However, because no ports are reserved for protection, unprotected schemes maximize the service available for use on the ONS 15600. **Note** If you want to protect traffic you should implement either a path protection or bidirectional line switched ring (BLSR) protection scheme.

Note Because there are no electrical cards in the ONS 15600, 1:1 or 1:N protection is not provided.

Figure 3-1 shows an example of the ONS 15600 in a maximum, 1+1 protected configuration.

Figure 3-1 ONS 15600 in a 1+1 Protected Configuration



With 1+1 protection, any port can be assigned to protect the traffic of a corresponding working port. A working port must be paired with a protect port of the same type, for example, an OC-48 port must be paired with another OC-48 port.

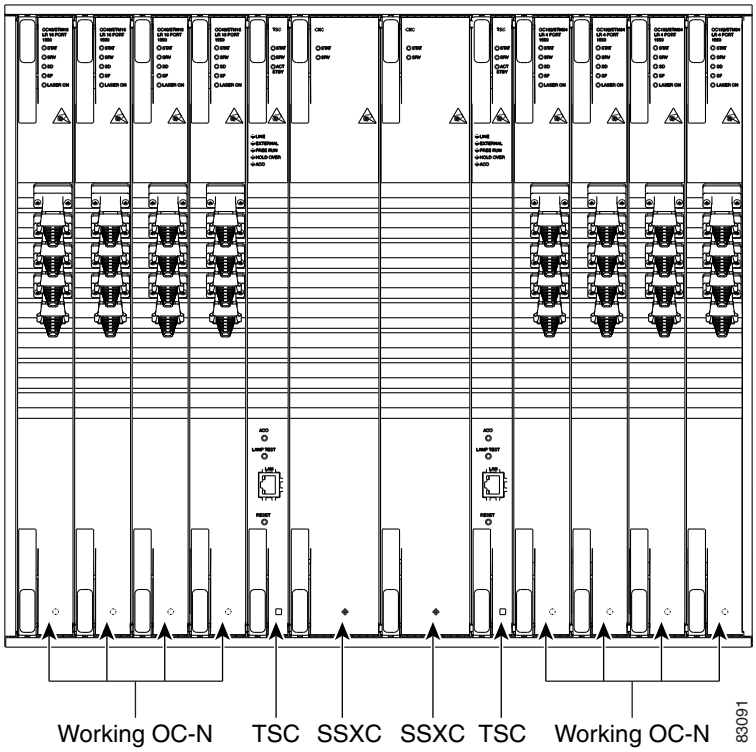
1+1 span protection can be either revertive or nonrevertive. With nonrevertive 1+1 protection, when a span failure occurs and the signal switches from the working port to the protect port, the signal stays switched to the protect port until it is manually switched back. Revertive 1+1 protection automatically switches the signal back to the working port when the failure condition on the working port is cleared.

For more information about protection schemes and how to create and modify them with Cisco Transport Controller (CTC), refer to the *Cisco ONS 15600 Procedure Guide*.

3.2 Unprotected Ports

Unprotected ports are not included in a protection scheme; therefore, a port failure or a signal error can result in data loss if no path level protection (path protection) exists. Because no bandwidth lies in reserve for protection, unprotected schemes maximize the available ONS 15600 bandwidth. Figure 3-2 shows the ONS 15600 in an unprotected configuration. All ports are in a working state.

Figure 3-2 ONS 15600 in an Unprotected Configuration



3.3 External Switching Commands

The external switching commands on the ONS 15600 are Manual, Force, Lockout, and Lock-on.

A Manual switch will switch traffic if the path has an error rate less than the signal degrade. A Force switch will switch traffic even if the path has signal degrade (SD) or signal fail (SF) conditions; however, a Force switch will not override an SF on a 1+1 protection scheme. A Force switch has a higher priority than a Manual switch.

Lockouts prevent traffic from switching to the protect port under any circumstance, thus they can only be applied to protect cards. Lockouts have the highest priority. Another way to inhibit protection switching in a 1+1 configuration is to apply a lock- on to the working port. A working port with a lock-on applied cannot switch traffic to the protect port in the protection group (pair).

Cisco Transport Controller Operation

This chapter describes Cisco Transport Controller (CTC), the Cisco ONS 15600 software interface that is stored on the Timing and Shelf Controller (TSC) card and downloaded to your workstation each time you log into the ONS 15600. For CTC setup and login information, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 4.1 CTC Software Delivery Methods, page 4-1
- 4.2 CTC Installation Overview, page 4-2
- 4.3 PC and UNIX Workstation Requirements, page 4-3
- 4.4 CTC Login, page 4-4
- 4.5 CTC Window, page 4-6
- 4.6 CTC Card Reset, page 4-15
- 4.7 TSC Card Database, page 4-15
- 4.8 Software Load Revert, page 4-16

4.1 CTC Software Delivery Methods

Use CTC to provision and administer the ONS 15600. CTC is a Java application that is installed in two locations:

- ONS 15600 TSC card
- PCs and UNIX workstations that connect to the ONS 15600

CTC is stored on the TSC card and is downloaded to your workstation each time you log into an ONS 15600.

4.1.1 CTC Software Installed on the TSC Card

CTC software is preloaded on the ONS 15600 TSC cards; therefore, you do not need to install software on the TSC. To upgrade to a newer CTC software version, refer to the release-specific upgrade document.

You can view the software versions that are installed on one ONS 15600 by clicking the Maintenance > Software tabs in node view. Click the tabs in network view to display the software versions installed on all the network nodes.

4.1.2 CTC Software Installed on the PC or UNIX Workstation

When you connect to the ONS 15600, the TSC card automatically downloads the CTC software to your computer, where it is automatically installed if you have the correct Java Runtime Environment (JRE). The automatic download/installation process ensures that your computer is running the same CTC software version as the TSC you are accessing. The CTC software files are stored in the temporary directory designated by your computer's operating system. You can use the Delete CTC Cache button to remove files stored in the temporary directory. If the files are deleted, they are downloaded the next time you connect to an ONS 15600. Downloading the Java archive (JAR) files for CTC takes several minutes depending on the bandwidth of the connection between your workstation and the ONS 15600. For example, JAR files downloaded from a modem or a SONET data communications channel (SDCC) network link requires more time than JAR files downloaded over a LAN connection.

During network topology discovery, CTC polls each node in the network to determine which one contains the most recent version of the CTC software. If CTC discovers a node in the network that has a more recent version of the CTC software than the version you are currently running, CTC generates a message stating that a later version of the CTC has been found in the network, and offers to install the CTC software upgrade. If you have network discovery disabled, CTC will not seek more recent versions of the software. Unreachable nodes are not included in the upgrade discovery.

Note Upgrading the CTC software will overwrite your existing software. You must restart CTC after the upgrade is complete.

4.2 CTC Installation Overview

To connect to an ONS 15600 using CTC, enter the ONS 15600 IP address in the URL field of a web browser, such as Netscape Navigator or Microsoft Internet Explorer. After connecting to an ONS 15600, the following events occur automatically:

Note Each ONS 15600 has a unique IP address that you use to access the ONS 15600. The initial IP address, 192.168.1.2, is the default address for ONS 15600 access and configuration.

1. A CTC launcher applet is downloaded from the TSC to your computer's temporary directory. (If these files are deleted, they are automatically reinstalled the next time you connect to the ONS 15600.)
2. The launcher determines whether your computer has a CTC release matching the release on the ONS 15600 TSC.
3. If the computer does not have CTC installed, or if the installed release is older than the TSC version, the launcher downloads the CTC program files from the TSC.
4. The launcher starts CTC. The CTC session is separate from the web browser session, so the web browser is no longer needed. If you log into an ONS 15600 that is connected to ONS 15600s with older versions of CTC, or to Cisco ONS 15454s or ONS 15327s, CTC element files are downloaded automatically to enable you to interact with those nodes. You cannot interact with nodes on the network that have a newer software version than the node that you are logged into (the nodes will appear gray in network view). Therefore, always log into nodes with the latest software release.

Each ONS 15600 can handle up to 16 simultaneous CTC sessions. CTC performance might vary depending upon the volume of activity in each session.

Note You can also use TL1 commands to communicate with the ONS 15600 through VT100 terminals and VT100 emulation software, or you can telnet to an ONS 15600 using TL1 port 3083. Refer to the *Cisco ONS SONET TL1 Command Guide* for a comprehensive list of TL1 commands.

4.3 PC and UNIX Workstation Requirements

To use CTC with an ONS 15600, your computer must have a web browser with the correct JRE installed. The correct JRE and Java plug-in for the CTC software release are included on the Cisco ONS 15600 software CD.

To use CTC with an ONS 15600, your computer must have a web browser with the correct JRE installed. The correct JRE and Java plug-in for the CTC software release are included on the Cisco ONS 15600 software CD.

Note To avoid network performance issues, Cisco recommends managing a maximum of 50 nodes concurrently with CTC. The 50 nodes can be on a single DCC or split across multiple DCCs. Cisco does not recommend running multiple CTC sessions when managing two or more large networks.

To manage more than 50 nodes, Cisco recommends using Cisco Transport Manager (CTM). If you do use CTC to manage more than 50 nodes, you can improve performance by adjusting the heap size; see the "General Troubleshooting" chapter of the *Cisco ONS 15600 Troubleshooting Guide.* You can also create login node groups; see the "Connect the PC and Log Into the GUI" chapter of the *Cisco ONS 15600 Procedure Guide*.

Table 4-1 provides the minimum requirements for PCs and UNIX workstations.

Table 4-1 Minimum Computer Requirements for CTC

Area	Requirements	Notes
Processor (PC only)	Pentium 4 processor or equivalent	A faster CPU is recommended if your workstation runs multiple applications or if CTC manages a network with a large number of nodes and circuits.
RAM	512 MB or more	A minimum of 1 GB is recommended if your workstation runs multiple applications or if CTC manages a network with a large number of nodes and circuits.
Hard drive	20 GB hard drive with 50 MB of space available	CTC application files are downloaded from the TSC to your computer's Temp directory. These files occupy 5 to 10 MB of hard drive space.
Operating system	• PC: Windows 98, Windows NT 4.0, Windows 2000, or Windows XP • Workstation: Ultra 10 Sun running SunOS 6, 7, or 8	—

Table 4-1 Minimum Computer Requirements for CTC (continued)

Area	Requirements	Notes
Web browser	• PC: Netscape 4.76, Netscape 7.x, Internet Explorer 6.x • UNIX Workstation: Netscape 4.76, Netscape 7.x	For the PC, use JRE 1.4.2 or 5.0 with any supported web browser. For UNIX, use JRE 1.4.2 or 5.0with Netscape 7.x or JRE 1.3.1_02 with Netscape 4.76. Netscape 4.76 or 7.x is available at the following site: http://channels.netscape.com/ns/browsers/default.jsp Internet Explorer 6.x is available at the following site: http://www.microsoft.com
Java Runtime Environment	JRE 1.4.2 or 5.0	Though JRE 5.0 is compatible with Software R7.2, JRE 1.4.2 is the JRE version installed by the CTC Installation Wizard included on the Cisco ONS 15600 software CD. Cisco recommends that you use JRE 1.4.2 or 5.0 for networks with Software R7.2 nodes. If CTC must be launched directly from nodes running software earlier than R5.0, Cisco recommends JRE 1.3.1_02.
Cable	Use a crossover or straight-through LAN (CAT-5) cable to connect: • The ONS 15600 to a hub using the backplane RJ-45 ports, or to connect through a LAN. • The ONS 15600 to a PC using the backplane RJ-45 ports. • The active TSC RJ-45 port to a laptop or hub.	A direct PC-to-ONS 15600 connection means your computer is physically connected to the ONS 15600. This is most commonly done by connecting a LAN (CAT-5) straight-through cable from your PC to the RJ-45 port on the TSC. However, direct connections include connections to switches or hubs where the ONS 15600 is physically connected. **Note** Use only the active TSC connector for connectivity. If you connect to the standby or switch TSCs, you will lose connectivity. Cisco recommends that you use the RJ-45 connector on the Customer Access Panel (CAP) so that connection to the ONS 15600 will not be lost during a TSC switch.

4.4 CTC Login

After you have installed CTC, you can log in to a node using your browser. To log in, you must type the node IP address in the URL window. The CTC Login window appears.

The CTC Login window provides the following options to accelerate the login process.

- The Disable Network Discovery option omits the discovery of nodes with data communications channel (DCC) connectivity. To access all nodes with DCC connectivity, make sure that Disable Network Discovery is not checked. If you have network discovery disabled, CTC will not poll the

network for more recent versions of the software. (For more information about the automatic download of the latest CTC JAR files, see the "4.1.2 CTC Software Installed on the PC or UNIX Workstation" section on page 4-2.)

- The Disable Circuit Management option omits the discovery of circuits. To view circuits immediately after logging in, make sure that Disable Circuit Management is not checked. However, if disabled, after you have logged in you can click the Circuits tab and CTC will give you the option to enable circuit management.

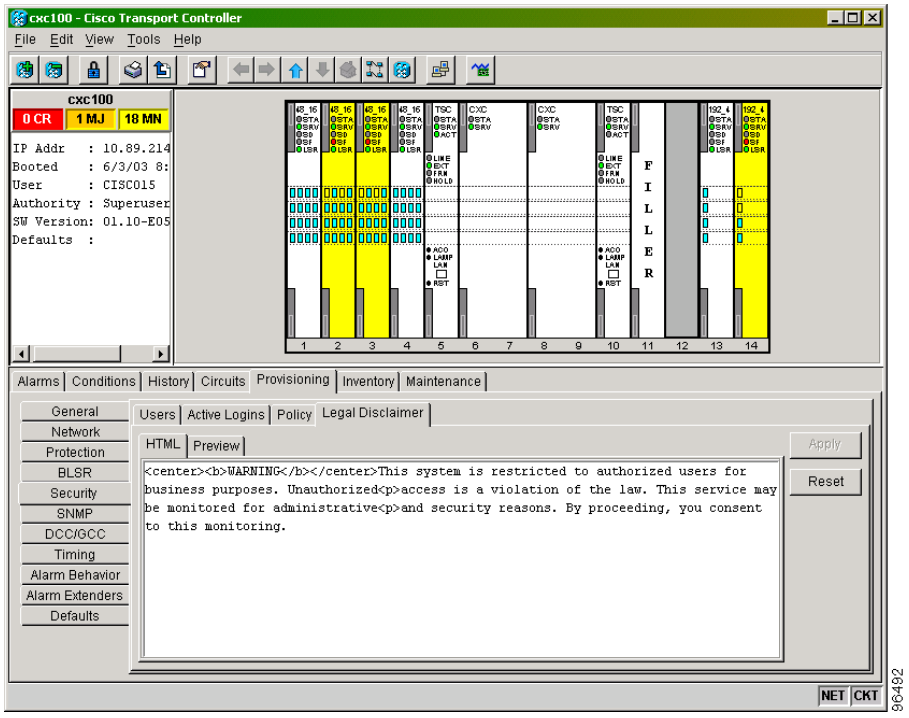
These options are useful if you want to log in to a node to perform a single task, such as placing a card in or out of service, and do not want to wait while CTC discovers DCC connections and circuits.

4.4.1 Legal Disclaimer

The CTC Login window currently displays the following warning message: "Warning: This system is restricted to authorized users for business purpose. Unauthorized access is a violation of the law. This service can be monitored for administrative and security reasons. By proceeding, you consent to this monitoring."

The ONS 15600 allows a user with Superuser privileges to modify the default login warning message and save it to a node using the Provisioning > Security > Legal Disclaimer > HTML tab (Figure 4-1). The login warning message field allows up to 250 characters of text (1600 characters total, including HTML markup).

Figure 4-1 Legal Disclaimer Tab



4.4.2 Login Node Group

Login node groups display nodes that have only an IP connection. After you are logged into CTC, you can create a login node group from the Edit > Preferences menu. Login groups appear in the Additional Nodes list on the Login window.

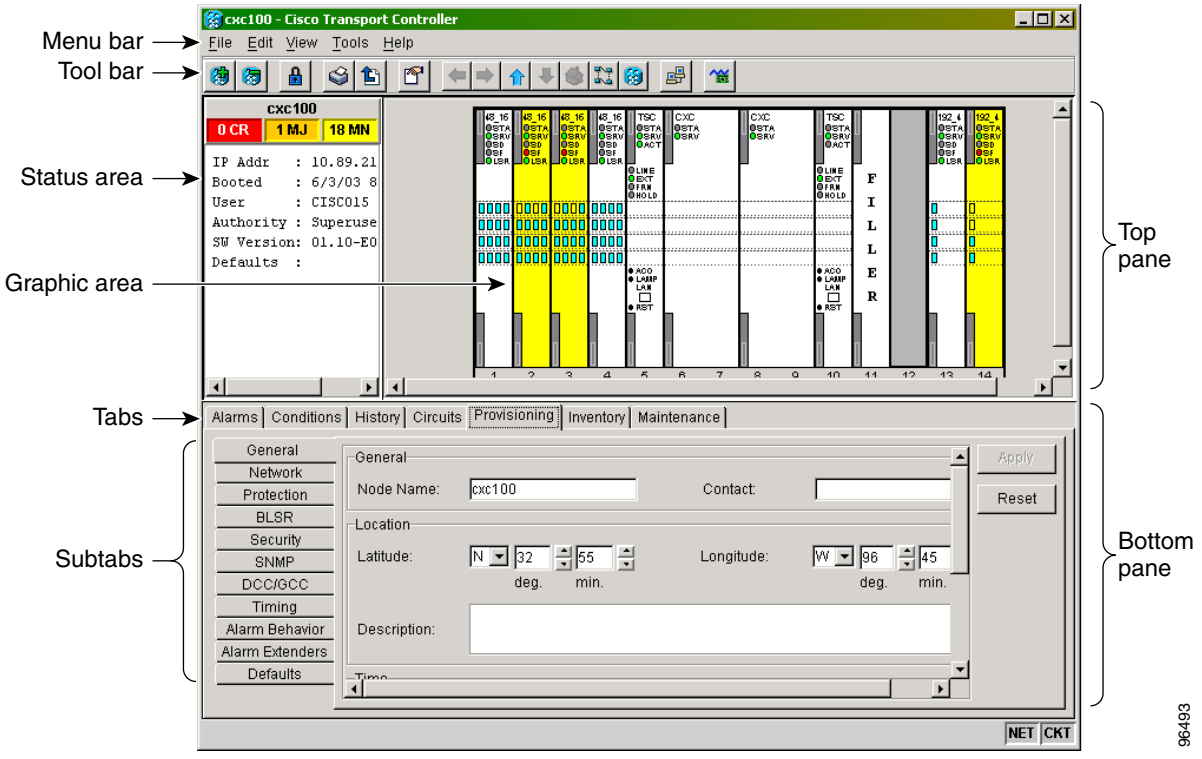
For example, if you logged into Node 1, you would see Node 2 and Node 3 because they have DCC connectivity to Node 1. You would not see Nodes 4, 5, and 6 because DCC connections do not exist. To view all six nodes at once, you create a login node group with the IP addresses of Nodes 1, 4, 5, and 6. Those nodes, and all nodes optically connected to them, appear when you select the login group from the Additional Nodes list on the Login window the next time you log in.

4.5 CTC Window

The CTC window appears after you log into an ONS 15600. The CTC node view is the first view that appears after you log into an ONS 15600 (Figure 4-2). The login node is the first node displayed, and it is the "home view" for the session (accessed by choosing View > Go To Home View).

The CTC window includes a menu bar, a toolbar, and a top and bottom pane. The top pane displays status information about the selected objects and a graphic of the current view. The bottom pane displays tabs and subtabs, which you use to view ONS 15600 information and perform ONS 15600 provisioning and maintenance. From the default node view window you can display the other two ONS 15600 views: network and card.

Figure 4-2 CTC Window Elements in the Node View (Default Login View)



4.5.1 Node View

Node view allows you to view and manage one ONS 15600 node (Figure 4-2). The status area shows the node name; number of Critical (CR), Major (MJ), and Minor (MN) alarms; IP address; session boot date and time; name of the current logged-in user; and user security level.

4.5.1.1 CTC Card Colors

The graphic area of the CTC window depicts the ONS 15600 shelf assembly. The colors of the cards in the graphic reflect the real-time status of the physical card, slot, and port. Table 4-2 describes the node view card colors.

Table 4-2 Node View Card Colors

Card Color	Status
Gray	Slot is not provisioned; no card is installed.
Violet	Slot is provisioned; no card is installed (the card immediately changes to yellow because the IMPROPRMVL alarm is raised).
White	Slot is provisioned; a functioning card is installed or booting.
Yellow	Slot is provisioned; a minor alarm condition exists.
Orange	Slot is provisioned; a major alarm condition exists.
Red	Slot is provisioned; a critical alarm exists.

Port color in both card and node view indicates the port service state. Table 4-3 lists the port colors and their service states. For more information about port service states, see Appendix B, "Administrative and Service States."

Table 4-3 Node View Card Port Colors and Service States

Port Color	Service State	Description
Blue	OOS-MA,LPBK	(Out-of-Service and Management, Loopback) Port is in a loopback state. On the card in node view, a line between ports indicates that the port is in terminal or facility loopback (see Figure 4-3 and Figure 4-4). Traffic is carried and alarm reporting is suppressed. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
Blue	OOS-MA,MT	(Out-of-Service and Management, Maintenance) Port is out-of-service for maintenance. Traffic is carried and loopbacks are allowed. Alarm reporting is suppressed. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command. Use OOS-MA,MT for testing or to suppress alarms temporarily. Change the state to IS-NR, OOS-MA,DSBLD, or OOS-AU,AINS when testing is complete.

Table 4-3 Node View Card Port Colors and Service States (continued)

Port Color	Service State	Description
Gray	OOS-MA,DSBLD	(Out-of-Service and Management, Disabled) The port is out-of-service and unable to carry traffic. Loopbacks are not allowed in this service state.
Green	IS-NR	(In-Service and Normal) The port is fully operational and performing as provisioned. The port transmits a signal and displays alarms; loopbacks are not allowed.
Violet	OOS-AU,AINS	(Out-of-Service and Autonomous, Automatic In-Service) The port is out-of-service, but traffic is carried. Alarm reporting is suppressed. The node monitors the ports for an error-free signal. After an error-free signal is detected, the port stays in OOS-AU,AINS state for the duration of the soak period. After the soak period ends, the port service state changes to IS-NR. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command. The AINS port will automatically transition to IS-NR when a signal is received for the length of time provisioned in the soak field.

Figure 4-3 Terminal Loopback Indicator

Figure 4-4 Facility Loopback Indicator

4.5.1.2 Node View Card Shortcuts

If you move your mouse over cards in the graphic, popups display additional information about the card including the card type; card status (active or standby); the type of alarm, such as critical, major, and minor (if any); and the alarm profile used by the card. Right-click a card to reveal a shortcut menu that you can use to open, reset, or delete a card. Right-click a slot to preprovision a card (that is, provision a slot before installing the card).

4.5.1.3 Node View Tabs

Table 4-4 lists the tabs and subtabs available in the node view.

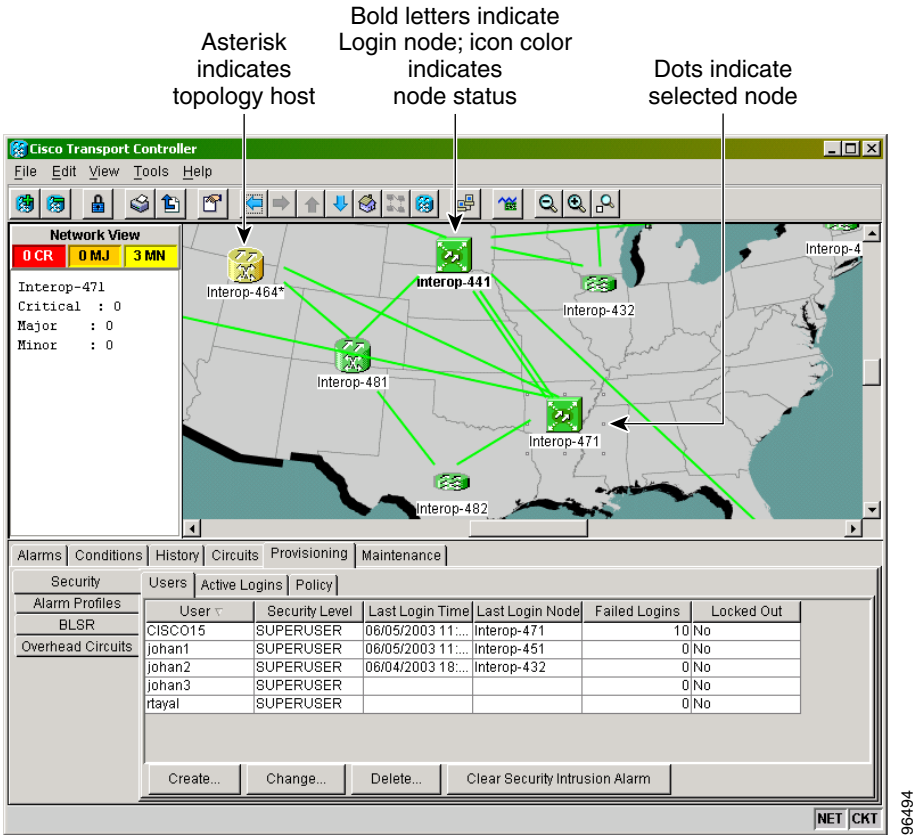
Table 4-4 Node View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the node and updates them in real time.	—
Conditions	Allows you to retrieve a list of standing conditions on the node.	—
History	Provides a history of node alarms including date, type, and severity of each alarm. The Session subtab displays alarms and events for the current session. The Node subtab displays alarms and events retrieved from a fixed-size log on the node.	Session, Node
Circuits	Allows you to create, delete, edit, and reroute circuits.	Circuits, Rolls
Provisioning	Allows you to provision the ONS 15600 node.	General, Network, OSI, BLSR, Protection, Security, SNMP, Comm Channels, Timing, Alarm Profiles, Alarm Extenders, Defaults
Inventory	Provides inventory information (part number, serial number, Common Language Equipment Identification [CLEI] codes) for cards installed in the node. Allows you to delete and reset cards, and change card service state. For more information on card service states, see Appendix B, "Administrative and Service States."	—
Maintenance	Allows you to perform maintenance tasks for the node.	Database, OSI, Protection, BLSR, Software, Diagnostic, Timing, Audit, Routing Table, Test Access, Alarm Extenders, Preferred Copy

4.5.2 Network View

Network view allows you to view and manage ONS 15600s, ONS 15454s, and ONS 15327s that have DCC connections to the node that you logged into and any login node groups you have selected (Figure 4-5).

Figure 4-5 Network Displayed in CTC Network View



The graphic area displays a background image with colored node icons. A Superuser can set up the logical network view feature, which enables each user to see the same network view.

Lines show DCC connections between the nodes. Selecting a link in the graphic area displays information about the node and span in the status area. See the "4.5.2.3 Link Consolidation" section on page 4-11 for more information.

4.5.2.1 CTC Node Colors

The node icon colors indicate the node status (Table 4-5).

Table 4-5 Node Status

Color	Alarm Status
Green	No alarms
Yellow	Highest-level alarm is a minor alarm
Orange	Highest-level alarm is major alarm
Red	Highest-level alarm is a critical alarm
Gray with node name	Node is initializing
Gray with IP address	Node is initializing; a problem exists with IP routing from node to CTC or your login/password is not provisioned on this node

4.5.2.2 Network View Tabs

Table 4-6 lists the tabs and subtabs available in the network view.

Table 4-6 Network View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the network and updates them in real time	—
Conditions	Displays a list of standing conditions on the network	—
History	Provides a history of network alarms including date, type, and severity of each alarm	—
Circuits	Create, delete, edit, filter and search for network circuits	Circuits, Rolls
Provisioning	Provision security, alarm profiles, bidirectional line switched rings (BLSRs), and overhead circuits	Security, Alarm Profiles, BLSR, Overhead Circuits, Provisionable Patchcords (PPC)
Maintenance	Displays the type of equipment and the status of each node in the network; displays working and protect software versions, and allows software to be downloaded	Software

4.5.2.3 Link Consolidation

CTC provides the ability to consolidate multiple data communications channel (DCC), general communications channel (GCC), optical transport section (OTS), provisionable patchcord (PPC), and server trail links into one or more links. Link consolidation allows you to condense multiple inter-nodal links into a single link. The link consolidation sorts links by class, meaning that all DCC links are consolidated together, for example.You can access individual links within consolidated links using the right-click shortcut menu.

Each link has an associated icon (Table 4-7).

Table 4-7 Link Icons

Icon	Description
	DCC icon
	GCC icon
	OTS icon

Table 4-7 Link Icons

Icon	Description
	PPC icon
	Server Trail icon

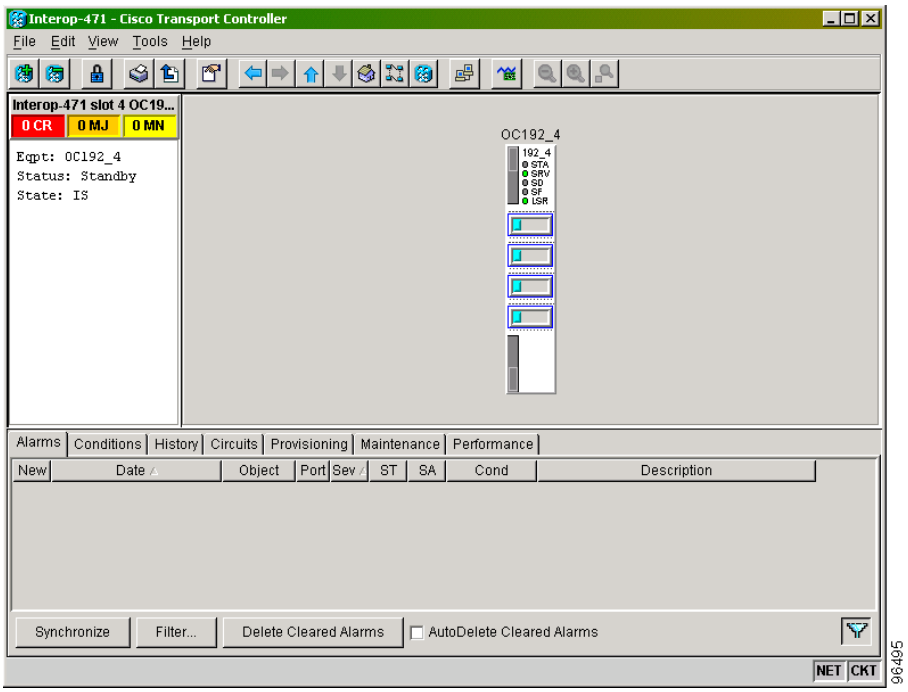
Note Link consolidation is only available on non-detailed maps. Non-detailed maps display nodes in icon form instead of detailed form, meaning the nodes appear as rectangles with ports on the sides. Refer to the *Cisco ONS 15600 Procedure Guide* for more information about consolidated links.

4.5.3 Card View

The card view provides information about individual ONS 15600 cards. Use this window to perform card-specific maintenance and provisioning (Figure 4-6). A graphic showing the ports on the card is shown in the graphic area. The status area displays the node name, slot, number of alarms, card type, equipment type, and the card status (active or standby), card service state if the card is present, and port service state (described in Table 4-3 on page 4-7). The information that appears and the actions you can perform depend on the card. For more information about card service states, see Appendix B, "Administrative and Service States."

Note CTC displays a card view for all ONS 15600 cards except the TSC and Single Shelf Cross-Connect (SSXC) cards. Provisioning for these common control cards occurs at the node view; therefore, no card view is necessary.

Figure 4-6 CTC Card View Showing an OC-192 Card



Use the card view tabs and subtabs, shown in Table 4-8, to provision and manage the ONS 15600. The subtabs, fields, and information displayed under each tab depend on the card type selected.

Table 4-8 Card View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the card and updates them in real time	—
Conditions	Displays a list of standing conditions on the card	—
History	Provides a history of card alarms including date, object, port, and severity of each alarm	Session (displays alarms and events for the current session); Card (displays alarms and events retrieved from a fixed-size log on the card)
Circuits	Create, delete, edit, and search circuits	Circuits, Rolls
Provisioning	Provision an ONS 15600 card	Line, SONET Thresholds, Optics Thresholds, SONET STS, and Alarm Profiles
Maintenance	Perform maintenance tasks for the card	Loopback, Transceiver, Protection, Path Trace, AINS Soak (options depend on the card type)
Performance	Perform performance monitoring for the card	—

4.5.4 Export and Print CTC Data

CTC data exported in HTML format can be viewed with any web browser, such as Netscape Communicator or Microsoft Internet Explorer. To display the data, use the browser's **File > Open** command to open the CTC data file.

CTC data exported as comma separated values (CSV) or tab separated values (TSV) can be viewed in text editors, word processors, spreadsheets, and database management applications. Although procedures depend on the application, you can typically use **File > Open** to display the CTC data. Text editors and word processors display the data exactly as it is exported. Spreadsheet and database management applications display the data in cells. You can then format and manage the data using the spreadsheet or database management application tools.

In addition to the CTC exporting, CTC text information can be copied and pasted into other applications using the Windows Copy (Ctrl-C), Cut (Ctrl-X), and Paste (Ctrl-V) commands. You can also print CTC windows and table data such as alarms and inventory by choosing **File > Print**. Table 4-9 shows the CTC tabs and subtabs that contain exportable data.

Table 4-9 Table Data with Export Capability

View or Card	Tab	Subtab(s)
Network	Alarms	—
	Conditions	—
	History	—
	Circuits	Circuits, Rolls
	Provisioning	Alarm Profiles
	Maintenance	Software
Node	Alarms	—
	Conditions	—
	History	Session, Node
	Circuits	Circuits, Rolls
	Provisioning	Network (General, Static Routing, OSPF, Internal Subnet)
		Alarm Behavior
	Inventory	—
	Maintenance	Software
		Audit
		Routing Table
		Test Access
		Alarm Extenders
		Logged on User

Table 4-9 Table Data with Export Capability (continued)

View or Card	Tab	Subtab(s)
OC-N Cards	Alarms	—
	Conditions	—
	History	Session, Card
	Circuits	Circuits, Rolls
	Provisioning	Line, Threshold, STS, Alarm Behavior
	Maintenance	Loopback, Transceiver, Protection
	Performance	—

4.6 CTC Card Reset

You can reset the ONS 15600 cards by using the hard-reset or soft-reset commands in CTC, or by physically reseating a card (card pull). From the node view, select a card and right-click to open a menu with the hard-reset and soft-reset commands. Soft resets do not impact traffic, however hard resets are service-affecting. A card must be in the Out-of-Service and Management, Maintenance (OOS-MA,MT) service state before you can perform a hard reset.

A soft reset on the TSC reboots the TSC and reloads the operating system and the application software. You can apply a CTC soft reset to either an active or standby TSC without affecting traffic. A CTC hard reset temporarily removes power from the TSC and clears all buffer memory.You should only perform a hard reset (or a card pull) on a standby TSC. If you need to perform a CTC hard reset or card pull on an active TSC, put the TSC into standby mode first by performing a soft reset.

A soft reset on an optical card with an active port in a 1+1 protection group will result in a loss of all DCC traffic terminated or tunneled on the active port for the duration of the reset time. A soft reset of an optical card with a standby port in a 1+1 protection group will not affect DCC traffic. A CTC hard reset of an optical card causes a switch to the protect card.

4.7 TSC Card Database

Each TSC card hosts a separate database; therefore, the protect card's database is available if the database on the working TSC fails. After a database change, there might be a 30-second interval before the TSC starts writing the data to the Flash drive. If you reset the active TSC immediately after a database change, the change could be lost.

You can also store a backup version of the database on the workstation running CTC. This operation should be part of a regular ONS 15600 maintenance program at approximately weekly intervals and should also be completed when preparing an ONS 15600 for a software upgrade or a pending natural disaster, such as a flood.

Note The Internet Inter-ORB Protocol (IIOP) port is not backed up and restored.

Note The ONS 15600 does not allow you to restore a database from one node to another node. You can install a database from one node on another node by using the Configure Node option on the **Maintenance > Database** tab.

4.8 Software Load Revert

Before you upgrade to Software Release 7.2, you must create a database backup. If you later need to restore the original working software load from the protect software load, CTC displays a prompt requesting the location of the backup. Any provisioning performed with Software R7.2 will be lost when the Software R1.1.x backup is restored.

Note After a software load is activated (upgraded to a higher software release), any circuits created and provisioning performed will not reinstate if an older database is restored. The database configuration at the time of activation is reinstated after a revert.

Security

This chapter provides information about Cisco ONS 15600 user security. To provision security, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 5.1 Users IDs and Security Levels, page 5-1
- 5.2 User Privileges and Policies, page 5-1
- 5.3 Audit Trail, page 5-6
- 5.4 RADIUS Security, page 5-7

5.1 Users IDs and Security Levels

When you log in to an ONS 15600 for the first time, you use the CISCO15 user ID, which is provided with every ONS 15600 system. You can use the CISCO15 ID, which has Superuser privileges, to create other ONS 15600 user IDs. For detailed instructions about creating users, refer to the *Cisco ONS 15600 Procedure Guide*.

Each ONS 15600 permits up to 500 Cisco Transport Controller (CTC) or TL1 user IDs. A user ID is assigned one of the following security levels:

- Superuser—Users can perform all of the functions of the other security levels as well as set names, passwords, and security levels for other users.
- Provisioning—Users can access provisioning and maintenance options.
- Maintenance—Users can access only the ONS 15600 maintenance options.
- Retrieve—Users can retrieve and view CTC information but cannot set or modify parameters.

See Table 5-3 on page 5-6 for idle user timeout information for each security level.

By default, multiple concurrent user ID sessions are permitted on the node, that is, multiple users can log into a node using the same user ID. However, you can provision the node to allow only a single login per user and prevent concurrent logins for all users.

5.2 User Privileges and Policies

This section lists user privileges for each CTC action and describes the security policies available to Superusers for provisioning.

5.2.1 User Privileges by Security Level

Table 5-1 shows the actions that each security level allows in node view. An "X" indicates that the action is supported on the associated security levels.

Table 5-1 ONS 15600 Security Levels—Node View

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
Alarms	—	Synchronize/ Filter/ Delete cleared alarms	X	X	X	X
Conditions	—	Retrieve/ Filter	X	X	X	X
History	Session	Filter	X	X	X	X
	Shelf	Retrieve/ Filter alarms and events	X	X	X	X
Circuits	Circuits	Create/Delete	—	—	X	X
		Edit/Filter/Search	X	X	X	X
	Rolls	Complete/ Force Valid Signal/ Finish	—	—	X	X
Provisioning	General	General: Edit	—	—	Partial[1]	X
	Network	General: Edit	—	—	—	X
		Static Routing: Create/Edit/Delete	—	—	X	X
		OSPF: Create/Edit/Delete	—	—	X	X
		Internal Subnet: Edit/Reset	—	—	X	X
		Proxy: Create/Edit/Delete	—	—	—	X
		Firewall: Create/Edit/Delete	—	—	—	X
	OSI	Main Setup: Edit	—	—	—	X
		TARP: Config: Edit	—	—	—	X
		TARP: Static TDC: Add/Edit/Delete	—	—	X	X
		TARP: MAT: Add/Edit/Remove	—	—	X	X
		Routers: Setup: Edit	—	—	—	X
		Routers: Subnets: Edit/Enable/Disable	—	—	X	X
		Tunnels: Create/Edit/Delete	—	—	X	X
	BLSR	Create/Edit/Delete/Upgrade	—	—	X	X
		Ring Map/Squelch Table/RIP Table	X	X	X	X
	Protection	Create/Delete/Edit	—	—	X	X

Table 5-1 ONS 15600 Security Levels—Node View (continued)

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
	Security	Users: Create/Delete/Clear Security Intrusion	—	—	—	X
		Users: Edit	Same user	Same user	Same user	All users
		Active Logins: View/Logout/ Retrieve Last Activity Time	—	—	—	X
		Policy: Edit/View	—	—	—	X
		Access: Edit/View	—	—	—	X
		RADIUS Server: Create/Edit/Delete/Move Up/Move D own/View	—	—	—	X
		Legal Disclaimer: Edit	—	—	—	X
	SNMP	Create/Edit/Delete	—	—	X	X
		Browse trap destinations	X	X	X	X
	Comm Channels	SDCC: Create/Edit/Delete	—	—	X	X
		LDCC: Create/Edit/Delete	—	—	X	X
	Timing	General: Edit	—	—	X	X
		BITS Facilities: Edit	—	—	X	X
	Alarm Profiles	Alarm Behaviour: Edit	—	—	X	X
		Alarm Profile Editor: Store/Delete[2]	—	—	X	X
		Alarm Profile Editor: New/Load/Compare/Available/Usage	X	X	X	X
	Alarm Extenders	External Alarms: Edit	—	—	X	X
		External Controls: Edit	—	—	X	X
	Defaults	Edit/Import	—	—	—	X
		Reset/Export	X	X	X	X
Inventory	—	Delete	—	—	X	X
		Hard-reset/Soft-reset	—	X	X	X
Maintenance	Database	Backup	—	X	X	X
		Restore	—	—	—	X
	Routing Table	Retrieve			X	X
	OSI	IS-IS RIB: Refresh	X	X	X	X
		ES-IS RIB: Refresh	X	X	X	X
		TDC: TID to NSAP/Flush Dynamic Entries	—	X	X	X
		TDC: Refresh	X	X	X	X
	BLSR	Edit/Reset	—	X	X	X

Table 5-1 ONS 15600 Security Levels—Node View (continued)

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
	Protection	Switch/Lock out/Lockon/Clear/ Unlock	—	X	X	X
	Software	Download	—	X	X	X
		Activate/Revert/Accept	—	—	—	X
	Diagnostic	Retrieve Diagnostic File	—	—	X	X
		Run Diagnostic test/Soft-reset	—	X	X	X
	Timing	Source: Edit	—	X	X	X
		Report: View/Refresh	X	X	X	X
	Audit	Retrieve	—	—	—	X
		Archive	—	—	X	X
	Test Access	View	X	X	X	X
	Alarm Extenders	External Alarms: View	X	X	X	X
		External Controls: View	X	X	X	X
		Virtual Wires: View/Retrieve	X	X	X	X
	Preferred Copy	Edit/Reset	—	—	—	X

1. Provisioner user cannot change node name, contact, location, or alarm indication signal–VT (AIS-V) insertion on STS-1 signal degrade (SD) parameters.
2. The action buttons in the subtab are active for all users, but the actions can be completely performed only by the users assigned with the required security levels.

Table 5-2 shows the actions that each user privilege level can perform in network view.

Table 5-2 ONS 15600 Security Levels—Network View

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
Alarms	—	Synchronize/Filter/Delete cleared alarms	X	X	X	X
Conditions	—	Retrieve/Filter	X	X	X	X
History	—	Filter	X	X	X	X
Circuits	Circuits	Create/Edit/Delete	—	—	X	X
		Filter/Search	X	X	X	X
	Rolls	Complete, Force Valid Signal, Finish	—	—	X	X

Table 5-2 ONS 15600 Security Levels—Network View (continued)

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
Provisioning	Security	Users: Create/Delete	—	—	—	X
		Users: Change	Same User	Same User	Same User	All Users
		Active logins: Logout/Retrieve Last Activity Time/View	—	—	—	X
		Policy: Edit/View	—	—	—	X
	Alarm Profiles	Store/Delete[1]	—	—	X	X
		New/Load/Compare/Available/ Usage	X	X	X	X
	BLSR	Create/Edit/Delete/Upgrade	—	—	X	X
	Overhead Circuits	Create/Delete/Edit/Merge	—	—	X	X
		Search	X	X	X	X
	Provisionable Patchcords (PPC)	Create/Delete	—	—	X	X
	Server Trails	Create/Edit/Delete	—	—	X	X
Maintenance	Software	Download/Cancel	—	X	X	X
	Diagnostics	Retrieve/Clear	X	X	X	X

1. The action buttons in the subtab are active for all users, but the actions can be completely performed only by the users assigned with the required security levels.

5.2.2 Security Policies

Users with Superuser security privileges can provision security policies on the ONS 15600. These security policies include idle user timeouts, password changes, password aging, and user lockout parameters.

5.2.2.1 Superuser Privileges for Provisioning Users

Superusers can grant permission to Provisioning users to perform a set of tasks, including retrieving the audit log, restoring a database, clearing performance monitoring (PM) parameters, activating a software load, and reverting a software load. These privileges can only be set using CTC network element (NE) defaults, except the PM clearing privilege, which can be granted using the CTC Provisioning > Security > Access tabs. For more information about setting up Superuser privileges, refer to the *Cisco ONS 15600 Procedure Guide*.

5.2.2.2 Idle User Timeout

Each ONS 15600 CTC or TL1 user has a specified amount of time to leave the system idle before the CTC window locks. CTC lockouts prevent unauthorized users from making changes. Higher-level users have shorter idle times and lower-level users have longer or unlimited default idle periods, as shown in Table 5-3. Superusers can change user idle times on the Provisioning > Security > Policy tabs.

Table 5-3 ONS 15600 User Idle Times

Security Level	Default Idle Time
Superuser	15 minutes
Provisioning	30 minutes
Maintenance	60 minutes
Retrieve	Unlimited

5.2.2.3 Superuser Password and Login Privileges

A Superuser can perform ONS 15600 user creation and management tasks from the network or node (default login) view. In network view, a Superuser can add, edit, or delete users from multiple nodes at one time. In node view, a Superuser can only add, edit, or delete users from that node.

Superuser password and login privilege criteria include:

- Privilege level—A Superuser can change the privilege level (such as Maintenance or Provisioning) of a user ID while the user is logged in. The change will become effective the next time the user logs in and will apply to all nodes within the network.
- Login visibility—Superusers can view real-time lists of users who are logged into a node (both CTC and TL1 logins) by retrieving a list of logins by node. A Superuser can also log out an active user.
- Password expiration and reuse settings—Superusers provision password reuse periods (the number of days before a user can reuse a password) and reuse intervals (the number of passwords a user must generate before reusing a password).
- User lockout settings—A Superuser can manually lock out or unlock a user ID.
- Invalid login attempts—A Superuser sets the number of invalid login attempts a user can make before the user ID is locked out. Additionally, the Superuser sets the time interval the user ID is locked out after the user reaches the login attempt limit.
- Single Session Per User—If the Superuser provisions a user ID to be active for a single occurrence only, concurrent logins with that user ID are not allowed.

5.3 Audit Trail

The ONS 15600 maintains a GR-839-compliant audit trail log that resides on the TSC card. This record shows who has accessed the system and what operations were performed during a given period of time. The log includes authorized Cisco logins and logouts using the operating system command line interface (CLI), CTC, and TL1; the log also includes FTP actions, circuit creation/deletion, and user/system generated actions.

Event monitoring is also recorded in the audit log. An event is defined as the change in status of an element within the network. External events, internal events, attribute changes, and software upload/download activities are recorded in the audit trail.

Audit trails are useful for maintaining security, recovering lost transactions and enforcing accountability. Accountability is the ability to trace user activities and is done by associating a process or action with a specific user. To view the audit trail log, refer to the “Manage Alarms” chapter in the *Cisco ONS 15600 Procedure Guide*. Users can access the audit trail logs from any management interface (CTC, CTM, TL1).

The audit trail is stored in persistent memory and is not corrupted by processor switches, resets or upgrades. However, if a user pulls both TSC cards, the audit trail log is lost.

5.3.1 Audit Trail Log Entries

Audit trail records capture the following activities:

- User—Name of the user performing the action
- Host—Host from where the activity is logged
- Device ID—IP address of the device involved in the activity
- Application—Name of the application involved in the activity
- Task—Name of the task involved in the activity (View a dialog, apply configuration and so on)
- Connection Mode—Telnet, Console, SNMP
- Category—Type of change; Hardware, Software, Configuration
- Status—Status of the user action (Read, Initial, Successful, Timeout, Failed)
- Time—Time of change
- Message Type—Denotes if the event is Success/Failure type
- Message Details—A description of the change

5.3.2 Audit Trail Capacities

The system is able to store 640 log entries.When this limit is reached, the oldest entries are overwritten with new events. When the log server is 80 percent full, an AUD-LOG-LOW condition is raised and logged (by way of CORBA/CTC).

When the log server reaches a maximum capacity of 640 entries and begins overwriting records that were not archived, an AUD-LOG-LOSS condition is raised and logged. This event indicates that audit trail records have been lost. Until the user off-loads the file, this event occurs once regardless of the amount of entries that are overwritten by the system. To export the audit trail log, refer to the *Cisco ONS 15600 Procedure Guide*.

5.4 RADIUS Security

Users with Superuser security privileges can configure nodes to use Remote Authentication Dial In User Service (RADIUS) authentication. Cisco Systems uses a strategy known as authentication, authorization, and accounting (AAA) for verifying the identity of, granting access to, and tracking the actions of remote users.

5.4.1 RADIUS Authentication

RADIUS is a system of distributed security that secures remote access to networks and network services against unauthorized access. RADIUS comprises three components:

- A protocol with a frame format that utilizes User Datagram Protocol (UDP)/IP
- A server

- A client

The server runs on a central computer typically at the customer's site, while the clients reside in the dial-up access servers and can be distributed throughout the network.

An ONS 15600 node operates as a client of RADIUS. The client is responsible for passing user information to designated RADIUS servers, and then acting on the response that is returned. RADIUS servers are responsible for receiving user connection requests, authenticating the user, and returning all configuration information necessary for the client to deliver service to the user. The RADIUS servers can act as proxy clients to other kinds of authentication servers. Transactions between the client and RADIUS server are authenticated through the use of a shared secret, which is never sent over the network. In addition, any user passwords are sent encrypted between the client and RADIUS server. This eliminates the possibility that someone snooping on an unsecured network could determine a user's password. Refer to the *Cisco ONS 15600 Procedure Guide* for detailed instructions for implementing RADIUS authentication.

5.4.2 Shared Secrets

A shared secret is a text string that serves as a password between:

- A RADIUS client and RADIUS server
- A RADIUS client and a RADIUS proxy
- A RADIUS proxy and a RADIUS server

For a configuration that uses a RADIUS client, a RADIUS proxy, and a RADIUS server, the shared secret that is used between the RADIUS client and the RADIUS proxy can be different than the shared secret used between the RADIUS proxy and the RADIUS server.

Shared secrets are used to verify that RADIUS messages, with the exception of the Access-Request message, are sent by a RADIUS-enabled device that is configured with the same shared secret. Shared secrets also verify that the RADIUS message has not been modified in transit (message integrity). The shared secret is also used to encrypt some RADIUS attributes, such as User-Password and Tunnel-Password.

When creating and using a shared secret:

- Use the same case-sensitive shared secret on both RADIUS devices.
- Use a different shared secret for each RADIUS server-RADIUS client pair.
- To ensure a random shared secret, generate a random sequence at least 22 characters long.
- You can use any standard alphanumeric and special characters.
- You can use a shared secret of up to 128 characters in length. To protect your server and your RADIUS clients from brute force attacks, use long shared secrets (more than 22 characters).
- Make the shared secret a random sequence of letters, numbers, and punctuation and change it often to protect your server and your RADIUS clients from dictionary attacks. Shared secrets should contain characters from each of the three groups listed in Table 5-4.

Table 5-4 Shared Secret Character Groups

Group	Examples
Letters (uppercase and lowercase)	A, B, C, D and a, b, c, d
Numerals	0, 1, 2, 3
Symbols (all characters not defined as letters or numerals)	Exclamation point (!), asterisk (*), colon (:)

The stronger your shared secret, the more secure are the attributes (for example, those used for passwords and encryption keys) that are encrypted with it. An example of a strong shared secret is 8d#>9fq4bV)H7%a3-zE13sW$hIa32M#m<PqAa72(.

Timing

This chapter provides information about Cisco ONS 15600 timing. To provision timing, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 6.1 Timing Parameters, page 6-1
- 6.2 Network Timing, page 6-2
- 6.3 Synchronization Status Messaging, page 6-3

6.1 Timing Parameters

SONET timing parameters must be set for each ONS 15600 node. Each ONS 15600 independently accepts its timing reference from one of three sources:

- The BITS (building integrated timing supply) pins on the Customer Access Panel (CAP).
- A port on an OC-N card installed in the ONS 15600. The timing is traceable to a node that receives timing through a BITS source.
- The internal Stratum 3E clock (ST3E) on the TSC card.

You can set ONS 15600 timing to one of three modes: external, line or mixed. If the timing comes from BITS, set ONS 15600 timing to external. If the timing comes from an OC-N port, set the timing to line. If the timing comes from both BITS and OC-N port, set ONS 15600 timing to mixed. In typical ONS 15600 networks:

- One node is set to external timing. The external node derives its timing from a BITS source wired to the BITS backplane pins. The BITS source, in turn, derives its timing from a Primary Reference Source (PRS), such as a Stratum 1 clock or GPS signal.
- Other nodes are set to line timing. The line nodes derive timing from the externally timed node through the OC-N trunk cards.

You can set three timing references for each ONS 15600. The first two references are typically two BITS-level sources, or two line-level sources optically traceable to a node with a BITS source. The third reference is the internal ST3E clock provided on every ONS 15600 TSC card. If an ONS 15600 becomes isolated, the TSC maintains timing at the ST3E level.

6.2 Network Timing

Figure 6-1 shows an ONS 15600 network timing example. Node 1 is set to external timing. Two timing references are Stratum 1 timing sources wired to the BITS input pins on the Node 1 backplane. The third reference is set to internal clock. The BITS output pins on the backplane of Node 3 are used to provide timing to outside equipment, such as a digital access line access multiplexer. In the event of a failure of one of the TSC modules, the redundant TSC module provides timing for BITS out. There are some restrictions on the provisioning of BITS out:

If the system is BITS timed:

- BITS-1 Out can have one reference if a 1+1 protected pair is chosen or two references can be selected if unprotected line sources are chosen.
- BITS-2 Out can have one reference if a 1+1 protected pair is chosen or two references can be selected if unprotected line sources are chosen.

If system is LINE timed:

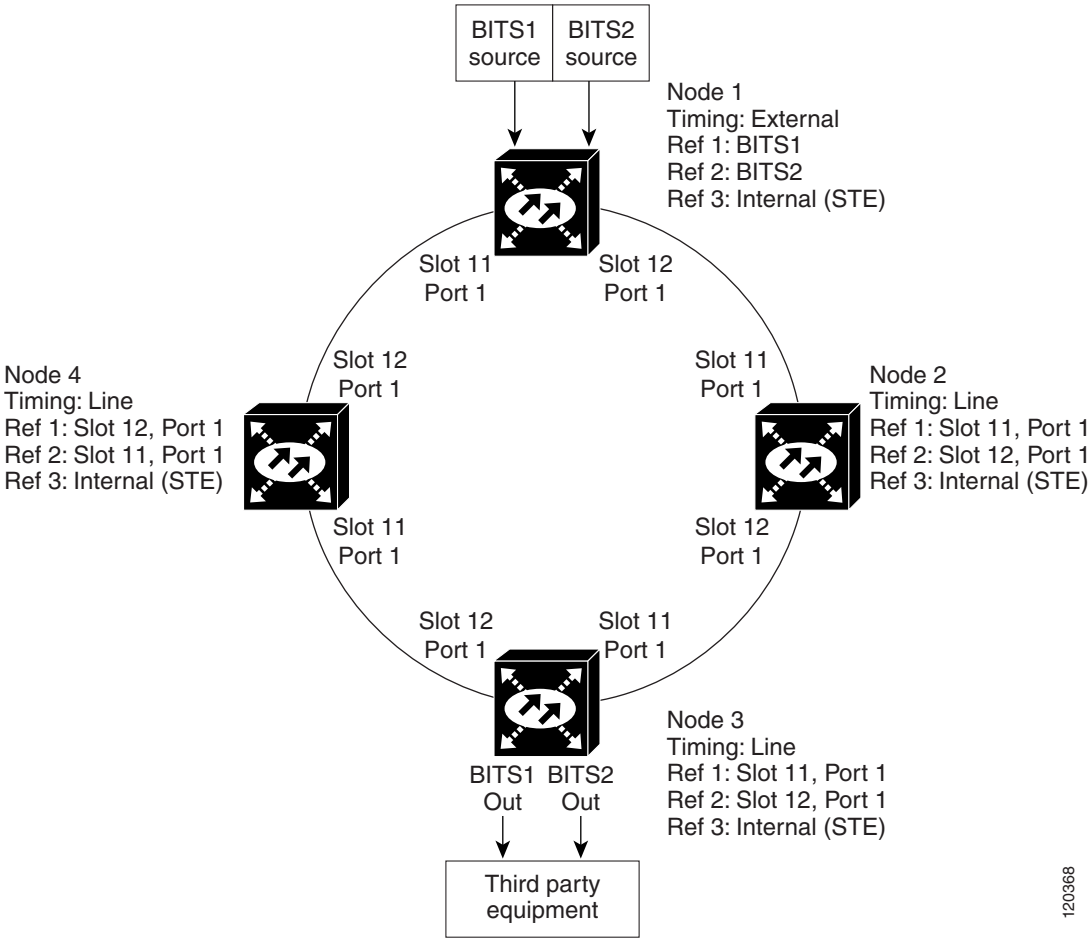
- BITS-1 Out can have one unprotected line source and either or both of the NE references.
- BITS-2 Out can have one unprotected line source and either or both of the NE references.

If the system is in mixed mode:

- BITS-1 Out can have one unprotected line source and any line source selected as NE reference Ref-1 or Ref-2.
- BITS-2 Out can have one unprotected line source and any line source selected as NE reference Ref-1 or Ref-2.

In the example, Slots 11 and 12 of Node 1 contain the trunk (span) cards. Timing at Nodes 2, 3, and 4 is set to line, and the timing references are set to the trunk cards according to the distance from the BITS source. Reference 1 is set to the trunk card closest to the BITS source. At Node 2, Reference 1 is Slot 11/Port 1 because it is connected to Node 1. At Node 4, Reference 1 is set to Slot 12/Port 1 because it is connected to Node 1. At Node 3, Reference 1 could be either trunk card because they are an equal distance from Node 1.

Figure 6-1 ONS 15600 Timing Example



6.3 Synchronization Status Messaging

Synchronization Status Messaging (SSM) is a SONET protocol that communicates information about the quality of the timing source. SSM messages are carried on the S1 byte of the SONET line layer. They enable SONET devices to automatically select the highest quality timing reference and to avoid timing loops.

SSM messages are either Generation 1 or Generation 2. Generation 1 is the first and most widely deployed SSM set. Generation 2 is a newer version. If you enable SSM for the ONS 15600, consult your timing reference documentation to determine which message set to use. Table 6-1 lists the Generation 1 message set.

Table 6-1 SSM Generation 1 Message Set

Message	Quality	Description
PRS	1	Primary reference source—Stratum 1
STU	2	Synchronization traceability unknown

Table 6-1 SSM Generation 1 Message Set (continued)

Message	Quality	Description
ST2	3	Stratum 2
ST3	4	Stratum 3
SMC	5	SONET minimum clock
ST4	6	Stratum 4
DUS	7	Do not use for timing synchronization
RES	—	Reserved; quality level set by user

Table 6-2 lists the Generation 2 message set.

Table 6-2 SSM Generation 2 Message Set

Message	Quality	Description
PRS	1	Primary reference source—Stratum 1
STU	2	Synchronization traceability unknown
ST2	3	Stratum 2
TNC	4	Transit node clock
ST3E	5	Stratum 3E
ST3	6	Stratum 3
SMC	7	SONET minimum clock
ST4	8	Stratum 4
DUS	9	Do not use for timing synchronization
RES	—	Reserved; quality level set by user

Circuits and Tunnels

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter explains Cisco ONS 15600 synchronous transport signal (STS) circuits and data communications channel (DCC) and IP-encapsulated tunnels. To provision circuits and tunnels, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 7.1 Overview, page 7-2
- 7.2 Circuit Properties, page 7-2
- 7.3 Cross-Connect Card Bandwidth, page 7-12
- 7.4 DCC Tunnels, page 7-12
- 7.5 Multiple Destinations for Unidirectional Circuits, page 7-13
- 7.6 Path Protection Circuits, page 7-13
- 7.7 Protection Channel Access Circuits, page 7-15
- 7.8 BLSR STS and VT Squelch Tables, page 7-16
- 7.9 Path Trace, page 7-17
- 7.10 Automatic Circuit Routing, page 7-18
- 7.11 Manual Circuit Routing, page 7-20
- 7.12 Constraint-Based Circuit Routing, page 7-21
- 7.13 Bridge and Roll, page 7-22
- 7.14 Merged Circuits, page 7-26
- 7.15 Reconfigured Circuits, page 7-27
- 7.16 Server Trails, page 7-27

Note In this chapter, "cross-connect" and "circuit" have the following meanings: cross-connect refers to the connections that occur within a single ONS 15600 to allow a circuit to enter and exit an ONS 15600. Circuit refers to the series of connections from a traffic source (where traffic enters the ONS 15600 network) to the destination (where traffic exits an ONS 15600 network).

7.1 Overview

You can create circuits across and within ONS 15454 nodes and assign different attributes to circuits. For example, you can:

- Create one-way, two-way (bidirectional), or broadcast circuits.
- Assign user-defined names to circuits.
- Assign different circuit sizes.
- Automatically or manually route circuits.
- Automatically create multiple circuits with autoranging.
- Provide full protection to the circuit path.
- Provide only protected sources and destinations for circuits.
- Define a secondary circuit source or destination that allows you to interoperate an ONS 15600 path protection with third-party equipment path protection configurations.
- Set path protection circuits as revertive or nonrevertive.

You can provision circuits at either of the following points:

- Before cards are installed. The ONS 15600 allows you to provision slot and circuits before installing the traffic cards.
- After you preprovision the small-form factor pluggables (SFPs) (also called provisionable port modules [PPMs]).
- Cards and SFPs are installed and ports are in service. Circuits do not actually carry traffic until the cards and SFPs are installed and the ports are In-Service and Normal (IS-NR); Out-of-Service and Autonomous, Automatic In-Service (OO-AU,AINS); or Out-of-Service and Management, Maintenance (OOS-MA,MT). Circuits will carry traffic as soon as the signal is received.

7.2 Circuit Properties

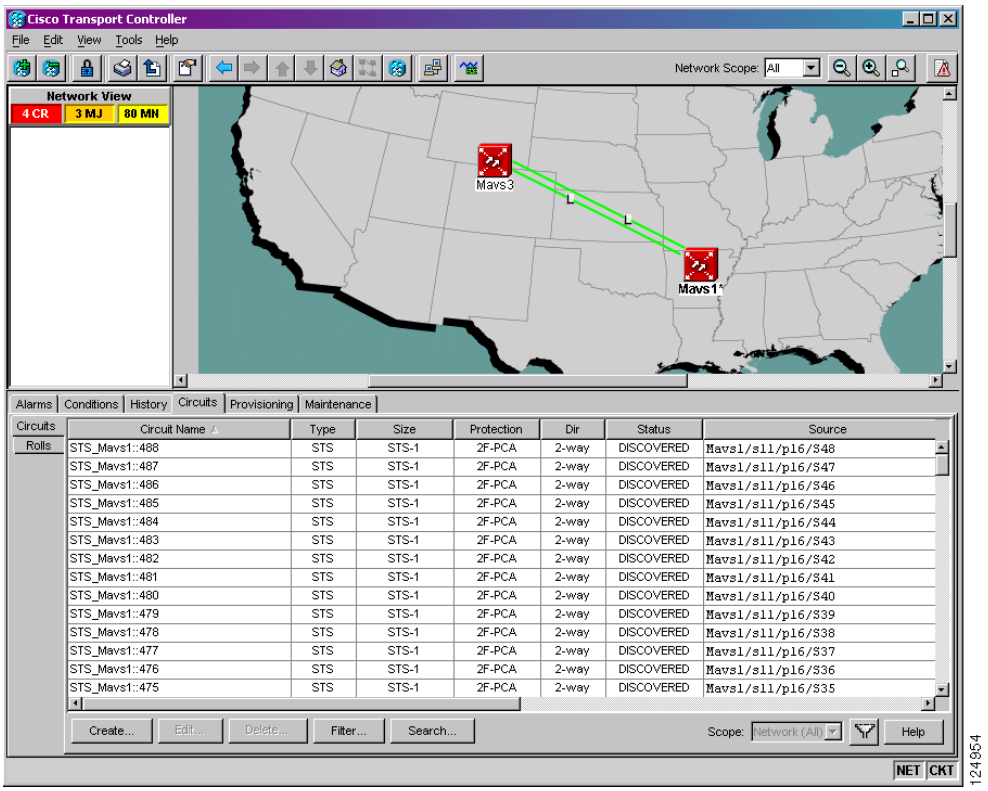
The ONS 15600 Circuits window (Figure 7-1 on page 7-3), which is available from network, node, and card view, is where you can view information about circuits, including:

- Name—The name of the circuit (user-assigned or automatically generated).
- Type—For the ONS 15600, the circuit type is STS (STS circuit).
- Size—The STS circuit size can be 1, 3c, 12c, 24c, 48c, or 192c. The STS circuit size for ASAP PPM ports also includes 6c and 9c. For time slot availability on concatenated STSs, see the "7.2.1 Concatenated STS Time Slot Assignments" section on page 7-4.
- Protection—The protection type; see the "7.2.4 Circuit Protection Types" section on page 7-8.

- Direction—The circuit direction, either two-way or one-way.
- Status—The circuit status; for details, see the "7.2.2 Circuit Status" section on page 7-6.
- Source—The circuit source in the format: *node/slot/port/STS*. If an ASAP PPM port is the circuit source, the port format is *PIM-PPM-port*, where pluggable interface module (PIM) and PPM values are 1 through 4 (for example, p1-1-1). PPMs have only one port.
- Destination—The circuit destination in the format: *node/slot/port/STS*. If an ASAP PPM port is the circuit destination, the port format is *PIM-PPM-port*, where PIM and PPM values are 1 through 4 (for example, p1-1-1). PPMs have only one port.
- # of VLANS—(Future use) The number of VLANs used by an Ethernet circuit.
- # of Spans—The number of internode links that constitute the circuit. Right-clicking the column shows a shortcut menu from which you can choose Span Details to show or hide circuit span detail. For each node in the span, the span detail shows the *node/slot (card type)/port/STS/VT*.
- State—The circuit state; for details, see the "7.2.3 Circuit States" section on page 7-7.

The Filter button allows you to filter the circuits in network, node, or card view based on circuit name, size, type, direction, and other attributes. In addition, you can export the Circuit window data in HTML, comma-separated values (CSV), or tab-separated values (TSV) format using the Export command from the File menu.

Figure 7-1 ONS 15600 Circuit Window in Network View


Cisco Transport Controller
File Edit View Tools Help
Network Scope: All
Network View
4 CR 3 MJ 80 MN
Mavs3
Mavs1
Alarms Conditions History Circuits Provisioning Maintenance
Circuits Rolls
Circuit Name Type Size Protection Dir Status Source
STS_Mavs1::488 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S48
STS_Mavs1::487 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S47
STS_Mavs1::486 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S46
STS_Mavs1::485 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S45
STS_Mavs1::484 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S44
STS_Mavs1::483 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S43
STS_Mavs1::482 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S42
STS_Mavs1::481 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S41
STS_Mavs1::480 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S40
STS_Mavs1::479 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S39
STS_Mavs1::478 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S38
STS_Mavs1::477 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S37
STS_Mavs1::476 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S36
STS_Mavs1::475 STS STS-1 2F-PCA 2-way DISCOVERED Mavs1/s11/p16/S35
Create... Edit... Delete... Filter... Search...
Scope: Network (All) Help
NET CKT
124954

The ONS 15600 supports up to 6144 STS-1 circuits. The Circuit Filter feature allows you to reduce the number of circuits that appear in the Circuits window. You can specify certain filter criteria, such as name, direction, and state; only the circuits that match the criteria will appear in the Circuits window.

Note You cannot set up VT circuits to terminate on an ONS 15600 node. However, you can create both STS and VT circuits that have an ONS 15454 or ONS 15327 source and destination with an ONS 15600 as a pass-through node. For information on VT circuit creation and tunneling, refer to the circuit chapters in the *Cisco ONS 15327 Reference Manual* and the *Cisco ONS 15454 Reference Manual*. Note that you cannot mix protection schemes, for example, 1+1 to path protection. Acceptable schemes are unprotected to unprotected, 1+1 to 1+1, BLSR to BLSR, and path protection to path protection.

7.2.1 Concatenated STS Time Slot Assignments

Table 7-1 shows the available time slot assignments for concatenated STSs when using Cisco Transport Controller (CTC) to provision circuits.

Table 7-1 STS Mapping Using CTC

Starting STS	STS-3c	STS-6c	STS-9c	STS-12c	STS-18c	STS-24c	STS-36c	STS-48c	STS-192c
1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
7	Yes	Yes	No	No	Yes	Yes	Yes	No	No
10	Yes	No	Yes	No	Yes	Yes	Yes	No	No
13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
16	Yes	Yes	Yes	No	Yes	Yes	No	No	No
19	Yes	Yes	Yes	No	Yes	Yes	No	No	No
22	Yes	No	No	No	Yes	Yes	No	No	No
25	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
28	Yes	Yes	Yes	No	Yes	No	No	No	No
31	Yes	Yes	No	No	Yes	No	No	No	No
34	Yes	No	No	No	No	No	No	No	No
37	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
40	Yes	Yes	Yes	No	No	No	No	No	No
43	Yes	Yes	No	No	No	No	No	No	No
46	Yes	No	Yes	No	No	No	No	No	No
49	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
52	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
55	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
58	Yes	No	No	No	Yes	Yes	Yes	No	No
61	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
64	Yes	Yes	Yes	No	Yes	Yes	No	No	No
67	Yes	Yes	No	No	Yes	Yes	No	No	No
70	Yes	No	No	No	Yes	Yes	No	No	No

Table 7-1 STS Mapping Using CTC (continued)

Starting STS	STS-3c	STS-6c	STS-9c	STS-12c	STS-18c	STS-24c	STS-36c	STS-48c	STS-192c
73	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
76	Yes	Yes	Yes	No	Yes	No	No	No	No
79	Yes	Yes	No	No	Yes	No	No	No	No
82	Yes	No	Yes	No	No	No	No	No	No
85	Yes	Yes	Yes	Yes	No	No	No	No	No
88	Yes	Yes	Yes	No	No	No	No	No	No
91	Yes	Yes	Yes	No	Yes	No	No	No	No
94	Yes	No	No	No	No	No	No	No	No
97	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
100	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
103	Yes	Yes	No	No	Yes	Yes	Yes	No	No
106	Yes	No	No	No	Yes	Yes	Yes	No	No
109	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
112	Yes	Yes	Yes	No	Yes	Yes	No	No	No
115	Yes	Yes	No	No	Yes	Yes	No	No	No
118	Yes	No	Yes	No	Yes	Yes	No	No	No
121	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
124	Yes	Yes	Yes	No	Yes	No	No	No	No
127	Yes	Yes	Yes	No	Yes	No	No	No	No
130	Yes	No	No	No	No	No	No	No	No
133	Yes	Yes	Yes	Yes	No	No	No	No	No
136	Yes	Yes	Yes	No	No	No	No	No	No
139	Yes	Yes	No	No	No	No	No	No	No
142	Yes	No	No	No	No	No	No	No	No
145	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
148	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
151	Yes	Yes	No	No	Yes	Yes	Yes	No	No
154	Yes	No	Yes	No	Yes	Yes	Yes	No	No
157	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
160	Yes	Yes	Yes	No	Yes	Yes	No	No	No
163	Yes	Yes	Yes	No	Yes	Yes	No	No	No
166	Yes	No	No	No	Yes	Yes	No	No	No
169	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
172	Yes	Yes	Yes	No	Yes	No	No	No	No
175	Yes	Yes	No	No	Yes	No	No	No	No

Table 7-1 STS Mapping Using CTC (continued)

Starting STS	STS-3c	STS-6c	STS-9c	STS-12c	STS-18c	STS-24c	STS-36c	STS-48c	STS-192c
178	Yes	No	No	No	No	No	No	No	No
181	Yes	Yes	Yes	Yes	Yes	No	No	No	No
184	Yes	Yes	Yes	No	Yes	No	No	No	No
187	Yes	Yes	No	No	Yes	No	No	No	No
190	Yes	No	No	No	Yes	No	No	No	No

7.2.2 Circuit Status

The circuit statuses that appear in the Circuit window Status column are generated by CTC based on an assessment of conditions along the circuit path. Table 7-2 shows the statuses that can appear in the Status column.

Table 7-2 ONS 15600 Circuit Status

Status	Definition/Activity
CREATING	CTC is creating a circuit.
DISCOVERED	CTC created a circuit. All components are in place and a complete path exists from circuit source to destination.
DELETING	CTC is deleting a circuit.
PARTIAL	A CTC-created circuit is missing a connection or circuit span (network link), a complete path from source to destination(s) does not exist, or a MAC address change occurred on one of the circuit nodes and the circuit is in need of repair (in the ONS 15454, the MAC address resides on the AIP; in the ONS 15600, the MAC address resides on the backplane EEPROM). In CTC, circuits are represented using cross-connects and network spans. If a network span is missing from a circuit, the circuit status is PARTIAL. However, a PARTIAL status does not necessarily mean a circuit traffic failure has occurred, because traffic might flow on a protect path. Network spans are in one of two states: up or down. On CTC circuit and network maps, up spans appear as green lines, and down spans appear as gray lines. If a failure occurs on a network span during a CTC session, the span remains on the network map but its color changes to gray to indicate that the span is down. If you restart your CTC session while the failure is active, the new CTC session cannot discover the span and its span line does not appear on the network map. Subsequently, circuits routed on a network span that goes down appear as DISCOVERED during the current CTC session, but appear as PARTIAL to users who log in after the span failure.

Table 7-2 ONS 15600 Circuit Status (continued)

Status	Definition/Activity
DISCOVERED_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is complete. A complete path from source to destination(s) exists.
PARTIAL_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is missing a cross-connect or circuit span (network link), and a complete path from source to destination(s) does not exist.
CONVERSION_PENDING	An existing circuit in a topology upgrade is set to this state. The circuit returns to the DISCOVERED state when the topology upgrade is complete. For more information about topology upgrades, see Chapter 8, "SONET Topologies and Upgrades."
PENDING_MERGE	Any new circuits created to represent an alternate path in a topology upgrade are set to this status to indicate that it is a temporary circuit. These circuits can be deleted if a topology upgrade fails. For more information about topology upgrades, see Chapter 8, "SONET Topologies and Upgrades."
DROP_PENDING	A circuit is set to this status when a new circuit drop is being added.

Note If an ONS 15600 node is running Software R5.0.2, it is in a BLSR with an ONS 15454 node running Software R7.0 or later, and the login node is running Software R7.0 or later, the Protection column in the CTC Circuits window will show "Unknown" and the Status column will show "CONVERSION_PENDING." This status occurs until the ONS 15600 node is running Release 7.0 or later software.

7.2.3 Circuit States

The circuit service state is an aggregate of the cross-connect states within the circuit.

- If all cross-connects in a circuit are in the IS-NR service state, the circuit service state is In-Service (IS).
- If all cross-connects in a circuit are in an OOS service state, such as OOS-MA,MT; Out-of-Service and Autonomous, Automatic In-Service (OOS-AU,AINS); or Out-of-Service and Management, Disabled (OOS-MA,DSBLD) service state, the circuit service state is Out-of-Service (OOS).
- PARTIAL is appended to the OOS circuit service state when circuit cross-connects state are mixed and not all in IS-NR. The OOS-PARTIAL state can occur during automatic or manual transitions between states. OOS-PARTIAL can appear during a manual transition caused by an abnormal event such as a CTC crash or communication error, or if one of the cross-connects could not be changed. Refer to the *Cisco ONS 15600 Troubleshooting Guide* for troubleshooting procedures.

You can assign a service state to circuit cross-connects at two points:

- During circuit creation, you can set the state on the Create Circuit wizard.

- After circuit creation, you can change a circuit state in the Edit Circuit window or from the Tools > Circuits > Set Circuit State menu.

Note After you have created an initial circuit in a CTC session, the subsequent circuit states default to the circuit state of the initial circuit, regardless of which nodes in the network the circuits traverse or the node.ckt.state default setting.

During circuit creation, you can apply a service state to the drop ports in a circuit; however, CTC does not apply a requested state other than IS-NR to drop ports if:

- The port is a timing source.
- The port is provisioned for orderwire or tunnel orderwire.
- The port is provisioned as a DCC or DCC tunnel.
- The port supports 1+1 or BLSR.

Circuits do not use the soak timer, but ports do. The soak period is the amount of time that the port remains in the OOS-AU,AINS service state after a signal is continuously received. When the cross-connects in a circuit are in the OOS-AU,AINS service state, the ONS 15600 monitors the cross-connects for an error-free signal. It changes the state of the circuit from OOS to IS or to OOS-PARTIAL as each cross-connect assigned to the circuit path is completed. This allows you to provision a circuit using TL1, verify its path continuity, and prepare the port to go into service when it receives an error-free signal for the time specified in the port soak timer. For example, when assigning the IS,AINS administrative state to cross-connects in STS circuits, the circuit source and destination ports transition to the OOS-AU,AINS service state. When an alarm-free signal is received, the source and destination ports remain OOS-AU,AINS for the duration of the soak timer. After the port soak timer expires, STS source and destination ports change to IS-NR and the circuit service state to IS.

To find the remaining port soak time, choose the Maintenance > AINS Soak tabs in card view and click the Retrieve button. If the port is in the OOS-AU,AINS state and has a good signal, the Time Until IS column shows the soak count down status. If the port is OOS-AU,AINS and has a bad signal, the Time Until IS column indicates that the signal is bad. You must click the Retrieve button to obtain the latest time value.

For more information about cross-connect states, see Appendix B, “Administrative and Service States.”

7.2.4 Circuit Protection Types

The Protection column in the Circuit window shows the card (line) and SONET topology (path) protection used for the entire circuit path. Table 7-3 lists the protection type indicators that you will see in this column.

Table 7-3 Circuit Protection Types

Protection Type	Description
1+1	The circuit is protected by a 1+1 protection group.
2F BLSR	The circuit is protected by a 2-fiber BLSR.
2F-PCA	The circuit is routed on a protection channel access (PCA) path on a two-fiber BLSR. PCA circuits are unprotected.
DRI	The circuit is protected by dual-ring interconnection.
N/A	A circuit with connections on the same node is not protected.

Table 7-3 Circuit Protection Types (continued)

Protection Type	Description
Protected	The circuit is protected by diverse SONET topologies, for example a BLSR and a path protection, or a path protection and 1+1.
Unknown	A circuit has a source and destination on different nodes and communication is down between the nodes. This protection type appears if not all circuit components are known.
Unprot (black)	A circuit with a source and destination on different nodes is not protected.
Unprot (red)	A circuit created as a fully protected circuit is no longer protected due to a system change, such as removal of a BLSR or 1+1 protection group.
Path Protection	The circuit is protected by a path protection.

7.2.5 Circuit Information in the Edit Circuit Window

You can edit a selected circuit using the Edit button on the Circuits window. The tabs that appear depend on the circuit chosen:

- General—Displays general circuit information and allows you to edit the circuit name.
- Drops—Allows you to add a drop to a unidirectional circuit. For more information, see the "7.5 Multiple Destinations for Unidirectional Circuits" section on page 7-13.
- UPSR Selectors—Allows you to change UPSR selectors. For more information, see the "7.6 Path Protection Circuits" section on page 7-13.
- UPSR Switch Counts—Allows you to change path protection switch paths. For more information, see the "7.6 Path Protection Circuits" section on page 7-13.
- State—Allows you to edit cross-connect service states.
- Merge—Allows you to merge aligned circuits. For more information, see the "7.14 Merged Circuits" section on page 7-26.

Using the Export command from the File menu, you can export data from the UPSR Selectors, UPSR Switch Counts, State, and Merge tabs in HTML, comma-separated values (CSV), or tab-separated values (TSV) format.

The Show Detailed Map checkbox in the Edit Circuit window updates the graphical view of the circuit to show more detailed routing information, such as:

- Circuit direction (unidirectional or bidirectional)
- The nodes and STSs that the circuit traverses, including slots and port numbers
- The circuit source and destination points
- Open Shortest Path First (OSPF) area IDs
- Link protection (path protection, unprotected, BLSR, 1+1) and bandwidth (OC-N)

For BLSRs, the detailed map shows the number of BLSR fibers and the BLSR ring ID. For path protection configurations, the map shows the active and standby paths from circuit source to destination, and it also shows the working and protect paths. Selectors appear as pentagons on the detailed circuit map.

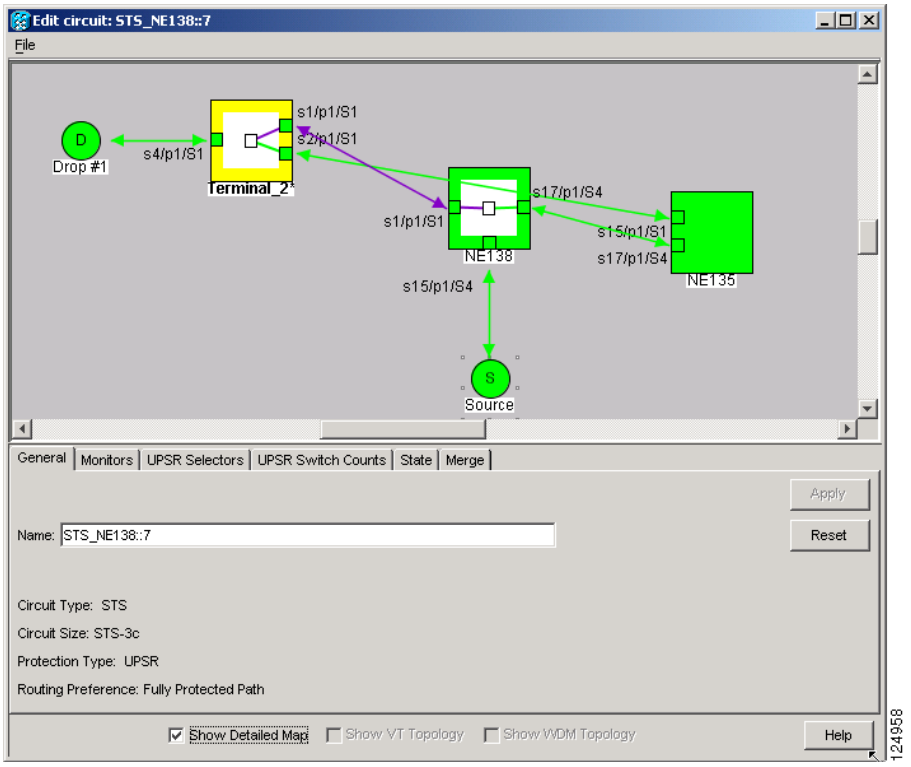
Alarms and states can also be viewed on the circuit map, including:

- Alarm states of nodes on the circuit route

- Number of alarms on each node organized by severity
- Port service states on the circuit route
- Alarm state/color of most severe alarm on port
- Loopbacks
- Path trace states
- Path selector states

Figure 7-2 shows a bidirectional STS circuit routed on a path protection.

Figure 7-2 Path Protection Circuit on the Edit Circuit Window



By default, the working path is indicated by a green, bidirectional arrow, and the protect path is indicated by a purple, bidirectional arrow. Source and destination ports are shown as circles with an S and D, respectively. Port states are indicated by colors, shown in Table 7-4.

Table 7-4 Port State Color Indicators

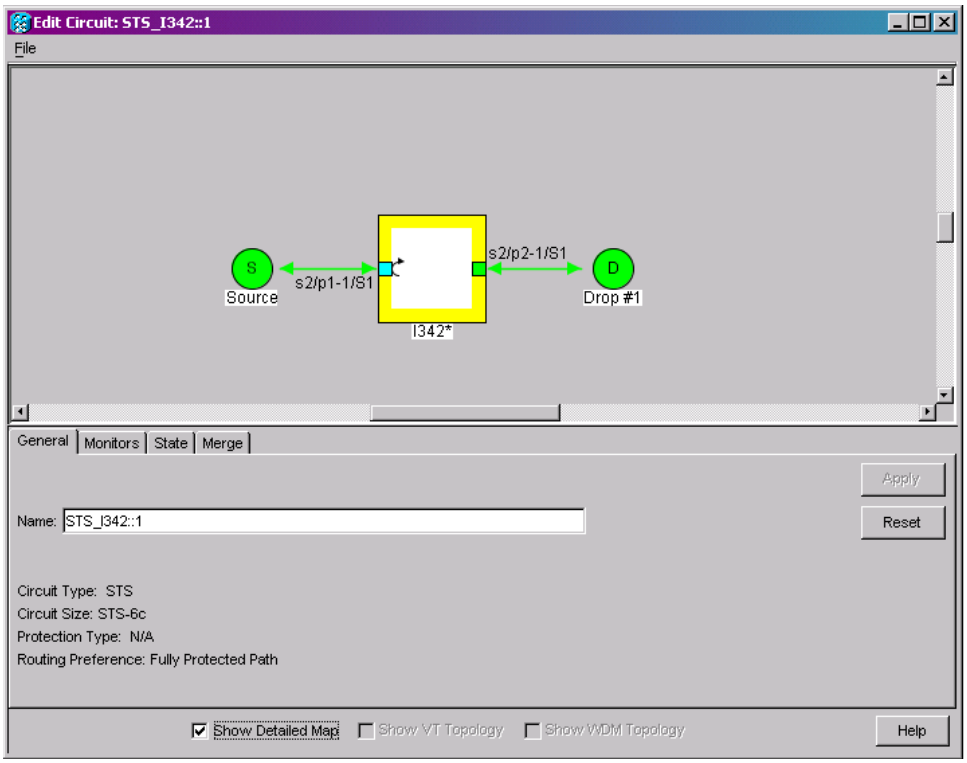
Port Color	Service State
Green	IS-NR
Gray	OOS-MA,DSBLD
Purple	OOS-AU,AINS
Cyan (Blue)	OOS-MA,MT

A notation within or by the squares or selector pentagons in detailed view indicates switches and loopbacks, including:

- F = Force switch
- M = Manual switch
- L = Lockout switch
- Arrow = Facility (outward) or terminal (inward) loopback

Figure 7-3 shows an example of the Edit Circuit window with a terminal loopback.

Figure 7-3 Detailed Circuit Map Showing a Terminal Loopback



Move the mouse cursor over nodes, ports, and spans to see tooltips with information including the number of alarms on a node (organized by severity), a port's service state, and the protection topology.

Right-click a node, port, or span on the detailed circuit map to initiate certain circuit actions:

- Right-click a unidirectional circuit destination node to add a drop to the circuit.
- Right-click a port containing a path-trace-capable card to initiate the path trace.
- Right-click a path protection span to change the state of the path selectors in the path protection circuit.

7.3 Cross-Connect Card Bandwidth

The single shelf cross-connect card (SSXC) cross-connect cards perform port-to-port, time-division multiplexing (TDM). The STS matrix has the capacity for 6144 STS terminations. Because each STS circuit requires a minimum of two terminations, one for ingress and one for egress, the SSXC has a capacity for 3072 STS circuits. However, this capacity is reduced at path protection and 1+1 nodes because three STS terminations are required at circuit source and destination nodes and four terminations are required at 1+1 circuit pass-through nodes. path protection pass-through nodes only require two STS terminations.

7.4 DCC Tunnels

SONET provides four data communications channels (DCCs) for network element operations, administration, maintenance, and provisioning: one on the SONET Section layer (DCC1) and three on the SONET Line layer (DCC2, DCC3, DCC4). The ONS 15600 uses the Section DCC (SDCC) for ONS 15600 management and provisioning. An SDCC and Line DCC (LDCC) each provide 192 Kbps of bandwidth per channel. The aggregate bandwidth of the three LDCCs is 576 Kbps. You can tunnel third-party SONET equipment across ONS 15600 networks using one of two tunneling methods, a traditional DCC tunnel or an IP-encapsulated tunnel.

7.4.1 Traditional DCC Tunnels

In traditional DCC tunnels, you can use the three Line DCCs (LDCCs) and the SDCC (when not used for ONS 15600 DCC terminations). A DCC tunnel endpoint is defined by slot, port, and DCC, where DCC can be either the SDCC or one of the LDCCs. You can link LDCCs to LDCCs and link SDCCs to SDCCs. You can also link an SDCC to an LDCC and an LDCC to an SDCC. To create a DCC tunnel, connect the tunnel endpoints from one ONS 15600 optical port to another. Table 7-5 lists the DCC tunnels that you can create.

Table 7-5 DCC Tunnels

DCC	SONET Layer	SONET Bytes
DCC1	Section	D1 to D3
DCC2	Line	D4 to D6
DCC3	Line	D7 to D9
DCC4	Line	D10 to D12

When you create DCC tunnels, keep the following guidelines in mind:

- Each ONS 15600 can have up to 64 DCC tunnel connections.
- An SDCC that is terminated cannot be used as a DCC tunnel endpoint.
- An SDCC that is used as an DCC tunnel endpoint cannot be terminated.
- All DCC tunnel connections are bidirectional.

7.4.2 IP-Encapsulated Tunnels

An IP-encapsulated tunnel puts an SDCC in an IP packet at a source node and dynamically routes the packet to a destination node. To compare traditional DCC tunnels with IP-encapsulated tunnels, a traditional DCC tunnel is configured as one dedicated path across a network and does not provide a failure recovery mechanism if the path is down. An IP-encapsulated tunnel is a virtual path, which adds protection when traffic travels between different networks.

IP-encapsulated tunneling has the potential of flooding the DCC network with traffic resulting in a degradation of performance for CTC. The data originating from an IP tunnel can be throttled to a user-specified rate, which is a percentage of the total SDCC bandwidth.

Each ONS 15600 supports up to 128 IP-encapsulated tunnels. You can convert a traditional DCC tunnel to an IP-encapsulated tunnel or an IP-encapsulated tunnel to a traditional DCC tunnel. Only tunnels in the DISCOVERED status can be converted.

Caution Converting from one tunnel type to the other is service-affecting.

7.5 Multiple Destinations for Unidirectional Circuits

Unidirectional circuits can have multiple destinations (drops) for use in broadcast circuit schemes. In broadcast scenarios, one source transmits traffic to multiple destinations, but traffic is not returned to the source. The ONS 15600 supports one of the following:

- Up to 2048 1:2 nonblocking broadcast connections
- Up to 682 1:*n* nonblocking broadcast connections (where *n* is less than or equal to 8)

When you create a unidirectional circuit, the card that does not have its backplane receive (Rx) input terminated with a valid input signal generates a Loss of Signal (LOS) alarm. To mask the alarm, create an alarm profile suppressing the LOS alarm and apply the profile to the port that does not have its Rx input terminated. To create an alarm profile, refer to the "Manage Alarms" chapter in the *Cisco ONS 15600 Procedure Guide*.

7.6 Path Protection Circuits

Use the Edit Circuit window to change path protection selectors and switch protection paths (Figure 7-4). In the path protection Selectors subtab in the Edit Circuits window, you can:

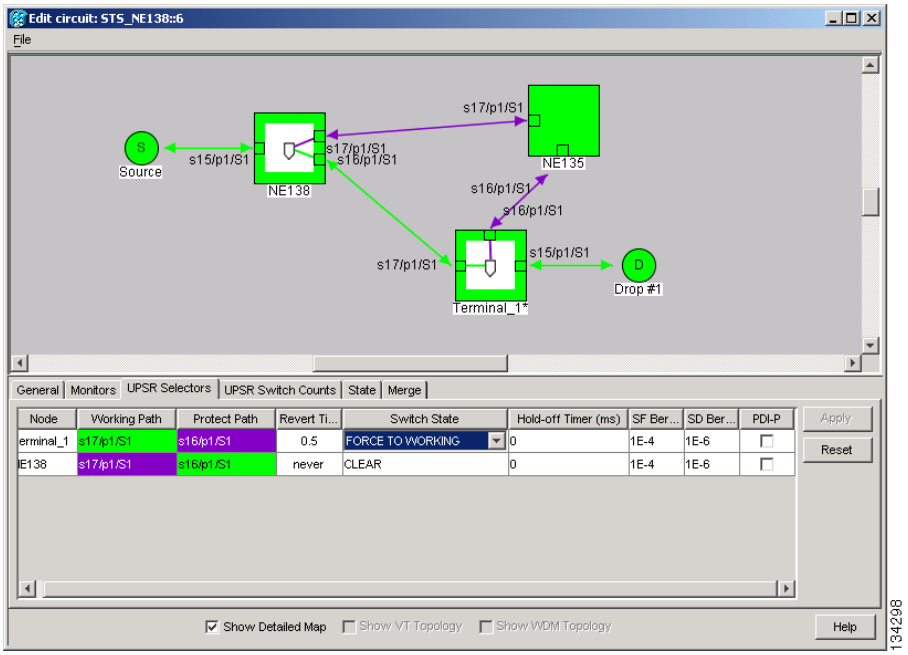
- View the path protection circuit's working and protection paths.
- Edit the reversion time.
- Set the hold-off timer.
- Edit the Signal Fail (SF) and Signal Degrade (SD) thresholds.
- Change Path Payload Defect Indication (PDI-P) settings.

Note In the UPSR Selectors tab, the SF Ber Level and SD Ber Level columns display "N/A" for those nodes that do not support VT signal bit error rate (BER) monitoring.

From the UPSR Switch Counts subtab, you can:

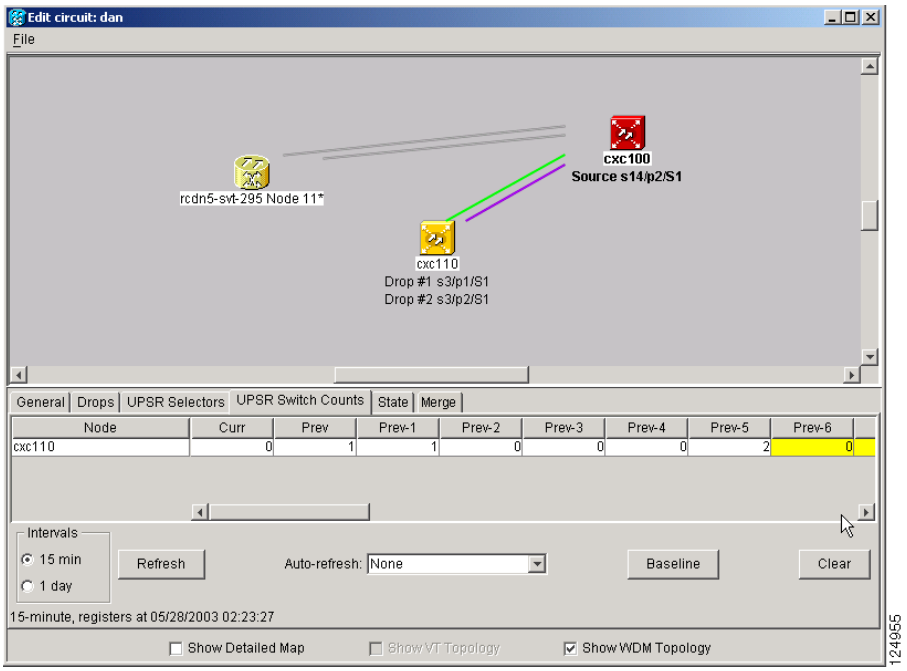
- Perform maintenance switches on the circuit selector.
- View switch counts for the selectors.

Figure 7-4 Editing Path Protection Selectors



On the UPSR Switch Counts tab, you can view switch counts for the selectors (Figure 7-5).

Figure 7-5 Viewing Path Protection Switch Counts



If ONS 15600s are connected to a third-party network, you can create an open-ended path protection circuit to route a circuit through it. To do this, you create three circuits. One circuit is created on the source ONS 15600 network. This circuit has one source and two destinations, one at each ONS 15600 that is connected to the third-party network. The second circuit is created on the third-party network so that the circuit travels across the network on two paths to the ONS 15600s. That circuit routes the two circuit signals across the network to ONS 15600s that are connected to the network on other side. At the destination node network, the third circuit is created with two sources, one at each node connected to the third-party network. A selector at the destination node chooses between the two signals that arrive at the node, similar to a regular path protection circuit.

7.7 Protection Channel Access Circuits

You can provision circuits to carry traffic on BLSR protection channels when conditions are fault-free and set up BLSR diagnostic test circuits. Traffic routed on BLSR PCA circuits, called extra traffic, has lower priority than the traffic on the working channels and has no means for protection. During ring or span switches, PCA circuits are preempted and squelched. For example, in a two-fiber OC-48 BLSR, STSs 25 to 48 can carry extra traffic when no ring switches are active, but PCA circuits on these STSs are preempted when a ring switch occurs. When the conditions that caused the ring switch are resolved and the ring switch is removed, PCA circuits are restored. If the BLSR is provisioned as revertive, this occurs automatically after the fault conditions are cleared and the reversion timer has expired.

Traffic provisioning on BLSR protection channels is performed during circuit provisioning. The Protection Channel Access check box appears whenever Fully Protected Path is unchecked on the circuit creation wizard. Refer to the *Cisco ONS 15600 Procedure Guide* for more information. When provisioning PCA circuits, two considerations are important to keep in mind:

- If BLSRs are provisioned as nonrevertive, PCA circuits are not restored automatically after a ring or span switch. You must switch the BLSR manually.

- PCA circuits are routed on working channels when you upgrade a BLSR from one optical speed to a higher optical speed. For example, if you upgrade a two-fiber OC-48 BLSR to an OC-192, STSs 25 to 48 on the OC-48 BLSR become working channels on the OC-192 BLSR.

7.8 BLSR STS and VT Squelch Tables

If a ONS 15600 is on a network with ONS 15454 and ONS 15327 nodes, it is possible to display STS and VT squelch tables on the ONS 15454 and ONS 15327 nodes depending on the type of circuits created. For example, if a fiber cut occurs, the BLSR squelch tables show STSs or VTs that will be squelched for every isolated node. Squelching replaces traffic by inserting the appropriate alarm indication signal path (AIS-P) and prevents traffic misconnections. For an STS with a VT-access check mark, the AIS-P will be removed after 100 ms. To view the squelch tables, refer to the "Manage Circuits" chapter in the *Cisco ONS 15454 Procedure Guide* for detailed instructions. For more information about BLSR squelching, refer to Telcordia GR-1230.

7.8.1 BLSR STS Squelch Table

BLSR STS squelch tables show STSs that will be squelched for every isolated node.

The BLSR Squelch Table window displays the following information:

- STS Number—Shows the BLSR STS numbers. For two-fiber BLSRs, the number of STSs is half the BLSR OC-N, for example, an OC-48 BLSR squelch table will show 24 STSs. For four-fiber BLSRs, the number of STSs in the table is the same as the BLSR OC-N.
- West Source—If traffic is received by the node on its west span, the BLSR node ID of the source appears. (To view the BLSR node IDs for all nodes in the ring, click the Ring Map button.)
- West VT (from the West Source) — A check mark indicates that the STS carries incoming VT traffic. The traffic source is coming from the west side.
- West VT (from the West Destination) — A check mark indicates that the STS carries outgoing VT traffic. The traffic is dropped on the west side.
- West Dest—If traffic is sent on the node's west span, the BLSR node ID of the destination appears.
- East Source—If traffic is received by the node on its east span, the BLSR node ID of the source appears.
- East VT — (from the East Source) - A check mark indicates that the STS carries incoming VT traffic. The traffic source is coming from the east side.
- East VT — (from the East Destination) - A check mark indicate that the STS carries outgoing VT traffic. The traffic is dropped on the east side.
- East Dest—If traffic is sent on the node's east span, the BLSR node ID of the destination appears.

Note BLSR squelching is performed on STSs that carry STS circuits only. Squelch table entries will not appear for STSs carrying VT circuits or Ethernet circuits to or from E-Series Ethernet cards provisioned in a multicard Ethergroup.

7.8.2 BLSR VT Squelch Table

BLSR VT squelch tables only appear on the node dropping VTs from a BLSR and are used to perform VT-level squelching when a node is isolated. VT squelching is supported on the ONS 15454 and the ONS 15327 platforms. The ONS 15600 platform does not support VT squelching; however, when an ONS 15454 or ONS 15327 and an ONS 15600 are in the same network, the ONS 15600 node allows the ONS 15454 or ONS 15327 node to carry VT circuits in a VT tunnel. The ONS 15600 performs 100-ms STS-level squelching for each VT-access STS at the switching node in case of a node failure.

When using a VT circuit on a VT tunnel (VTT), the VTT allows multiple VT circuits to be passed through on a single STS without consuming VT matrix resources on the cross-connect card. Both endpoints of the VTT are the source and destination nodes for the VTT. The node carrying VT circuits through a VTT is called a VT-access node. In case of a source and destination node failure of the VTT, the switching node performs 100-ms STS-level squelching for the VTT STS. The node dropping VT traffic performs VT-level squelching. VT traffic on the VTT that is not coming from the failed node is protected.

When using a VT circuit on a VT aggregation point (VAP), the VAP allows multiple VT circuits to be aggregated into a single STS without consuming VT matrix resources on the cross-connect card. The source for each VAP STS timeslot is the STS-grooming end where VT1.5 circuits are aggregated into a single STS. The destination for each VAP STS is the VT-grooming end where VT1.5 circuits originated. The source node for each VT circuit on a VAP is the STS-grooming end where the VT1.5 circuits are aggregated into a single STS. The STS grooming node is not a VT-access node. The non VT-access node performs STS-level squelching for each STS timeslot at the switching node in case the VT-grooming node fails. The node dropping VT traffic performs VT-level squelching for each VT timeslot in case the STS-grooming end node fails. No VT traffic on the VAP is protected during a failure of the STS-grooming node or the VT-grooming node.

To view the VT squelch table, double-click the VT with a check mark in the BLSR STS squelch table window. The check mark appears on every VT-access STS; however, the VT-squelch table appears only by double-clicking the check mark on the node dropping the VT. The intermediate node of the VT does not maintain the VT-squelch table.

The VT squelch table provides the following information:

- VT Number—Shows the BLSR VT numbers. The VT number includes VT group number and VT number in group (VT group 2 and channel 1 are displayed as 2-1.)
- West Source—If traffic is received by the node on its west span, the BLSR node ID of the source appears. (To view the BLSR node IDs for all nodes in the ring, click the Ring Map button.)
- East Source—If traffic is received by the node on its east span, the BLSR node ID of the source appears.

7.9 Path Trace

SONET J1 path trace is a repeated, fixed-length string that includes 64 consecutive J1 bytes. You can use the string to monitor interruptions or changes to circuit traffic. If the string received at a circuit drop port does not match the string the port expects to receive, the Trace Identifier Mismatch Path (TIM-P) alarm is raised. The ONS 15600 can also monitor a 16-byte ITU pattern.

Table 7-6 lists the ONS 15600 cards that support path trace.

Table 7-6 ONS 15600 Cards Supporting J1 Path Trace

Card	Receive	Transmit
OC48/STM16 SR/SH 16 Port 1310	Yes	No
OC48/STM16 LR/LH 16 Port 1550	Yes	No
OC192/STM64 SR/SH 4 Port 1310	Yes	No
OC192/STM64 LR/LH 4 Port 1550	Yes	No
ASAP OC-N ports	Yes	No
ASAP Ethernet ports	Yes	Yes

SONET J0 section trace is not supported on ONS 15600 cards

The ONS 15600 supports both automatic and manual J1 path trace monitoring to detect and report the contents of the 64-byte STS path trace message (nonterminated) for the designated STS path.

- Automatic—The receiving port assumes that the first J1 string it receives is the baseline J1 string.
- Manual—The receiving port uses a string that you manually enter as the baseline J1 string.

Note When J1 path trace is enabled on a two-fiber BLSR circuit, CTC will not retrieve the path trace information from the card view Maintenance > Path Trace subtab.

7.10 Automatic Circuit Routing

If you select automatic routing during circuit creation, CTC routes the circuit by dividing the entire circuit route into segments based on protection domains. For unprotected segments of circuits provisioned as fully protected, CTC finds an alternate route to protect the segment, creating a virtual path protection. Each segment of a circuit path is a separate protection domain. Each protection domain is protected in a specific protection scheme including card protection (1+1) or SONET topology (path protection or BLSR).

The following list provides principles and characteristics of automatic circuit routing:

- Circuit routing tries to use the shortest path within the user-specified or network-specified constraints.
- If you do not choose fully path protected during circuit creation, circuits can still contain protected segments. Because circuit routing always selects the shortest path, one or more links and/or segments can have some protection. CTC does not look at link protection while computing a path for unprotected circuits.
- Circuit routing does not use links that are down. If you want all links to be considered for routing, do not create circuits when a link is down.
- Circuit routing computes the shortest path when you add a new drop to an existing circuit. It tries to find the shortest path from the new drop to any nodes on the existing circuit.

7.10.1 Bandwidth Allocation and Routing

Within a given network, CTC routes circuits on the shortest possible path between source and destination based on the circuit attributes, such as protection and type. CTC considers using a link for the circuit only if the link meets the following requirements:

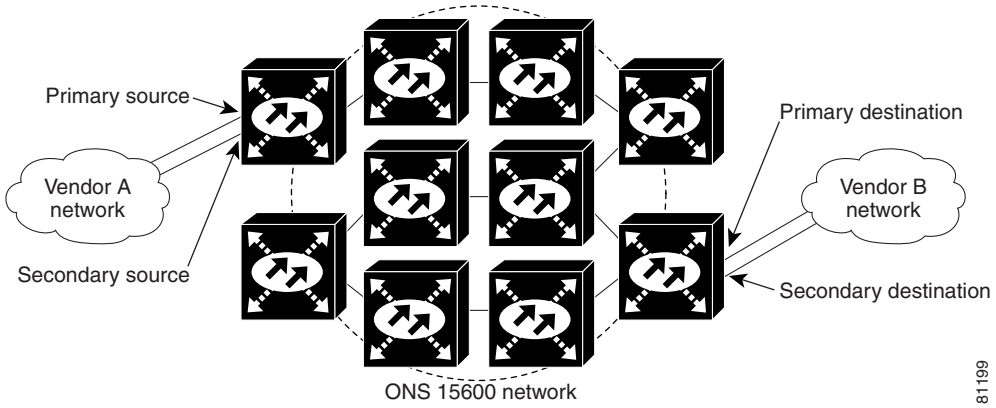
- The link has sufficient bandwidth to support the circuit.
- The link does not change the protection characteristics of the path.
- The link has the required time slots to enforce the same time slot restrictions for BLSR.

If CTC cannot find a link that meets these requirements, an error appears.

7.10.2 Secondary Sources and Destination

CTC supports secondary sources and destinations (drops). Secondary sources and destinations typically interconnect two third-party networks, as shown in Figure 7-6. Traffic is protected while it traverses a network of ONS 15600s.

Figure 7-6 Secondary Sources and Drops



Several rules apply to secondary sources and destinations:

- CTC does not allow a secondary destination for unidirectional circuits because you can specify additional destinations after you create the circuit.
- Primary and secondary sources should be on the same node.
- Primary and secondary destinations should be on the same node.
- Secondary sources and destinations are permitted only for regular STS connections.

For bidirectional circuits, CTC creates a path protection connection at the source node that allows traffic to be selected from one of the two sources on the ONS 15600 network. If you check the Fully Path Protected option during circuit creation, traffic is protected within the ONS 15600 network. At the destination, another path protection connection is created to bridge traffic from the ONS 15600 network to the two destinations. A similar but opposite path exists for the reverse traffic flowing from the destinations to the sources.

For unidirectional circuits, a path protection drop-and-continue connection is created at the source node.

Note Automatic routing and its associated subfields are not available if both the Automatic Circuit Routing NE default and the Network Circuit Automatic Routing Overridable NE default are set to FALSE. For a full description of these defaults see Appendix C, "Network Element Defaults."

7.11 Manual Circuit Routing

Routing circuits manually allows you to:

- Choose a specific path, not just the shortest path chosen by automatic routing.
- Choose a specific STS on each link along the route.

CTC imposes the following rules on manual routes:

- All circuits in a shared packet ring should have links with a direction that flows from source to destination.
- If you enabled Fully Protected Path, choose a diverse protect (alternate) path for every unprotected segment.
- For a node that has a path protection selector based on the links chosen, the input links to the path protection selectors cannot be 1+1 protected. The same rule applies at the path protection bridge.

If you enabled Fully Protected Path, CTC verifies that the route selection is protected at all segments. A route can have multiple protection domains with each domain protected by a different scheme.

Table 7-7 summarizes the available bidirectional connections. Any other combination is invalid and generates an error.

Table 7-7 Bidirectional STS Circuits

No. of Inbound Links	No. of Outbound Links	No. of Sources	No. of Drops	Connection Type
—	2	1	—	path protection
2	—	—	1	path protection
2	1	—	—	path protection
1	2	—	—	path protection
1	—	—	2	path protection
—	1	2	—	path protection
2	2	—	—	Double path protection
2	—	—	2	Double path protection
—	2	2	—	Double path protection
1	1	—	—	Two-way

Table 7-8 summarizes the available unidirectional connections. Any other combination is invalid and generates an error.

Table 7-8 Unidirectional STS Circuits

No. of Inbound Links	No. of Outbound Links	No. of Sources	No. of Drops	Connection Type
1	1	—	—	One-way
1	2	—	—	path protection head end
—	2	1	—	path protection head end
2	—	—	1+	path protection drop and continue

7.12 Constraint-Based Circuit Routing

When you create circuits, you can choose Fully Protected Path to protect the circuit from source to destination. The protection mechanism used depends on the path that CTC calculates for the circuit. If the network is comprised entirely of BLSR or 1+1 links, or the path between source and destination can be entirely protected using 1+1 or BLSR links, no path-protected mesh network (PPMN), or virtual path protection, protection is used.

If PPMN protection is needed to protect the path, set the level of node diversity for the PPMN portions of the complete path on the Circuit Routing Preferences area of the Circuit Creation dialog box:

- Nodal Diversity Required—Ensures that the primary and alternate paths of each PPMN domain in the complete path have a diverse set of nodes.
- Nodal Diversity Desired—CTC looks for a node-diverse path; if a node-diverse path is not available, CTC finds a link-diverse path for each PPMN domain in the complete path.
- Link Diversity Only—Creates only a link diverse path for each PPMN domain.

When you choose automatic circuit routing during circuit creation, you have the option to require or exclude nodes and links in the calculated route. You can use this option to achieve the following results:

- Simplify manual routing, especially if the network is large and selecting every span is tedious. You can select a general route from source to destination and allow CTC to fill in the route details.
- Balance network traffic; by default CTC chooses the shortest path, which can load traffic on certain links while other links are either free or use less bandwidth. By selecting a required node and/or a link, you force CTC to use (or not use) an element, resulting in more efficient use of network resources.

CTC considers required nodes and links to be an ordered set of elements. CTC treats the source nodes of every required link as required nodes. When CTC calculates the path, it makes sure the computed path traverses the required set of nodes and links and does not traverse excluded nodes and links.

The required nodes and links constraint is used only during the primary path computation and only for PPMN domains/segments. The alternate path is computed normally; CTC uses excluded nodes/links when finding all primary and alternate paths on PPMNs.

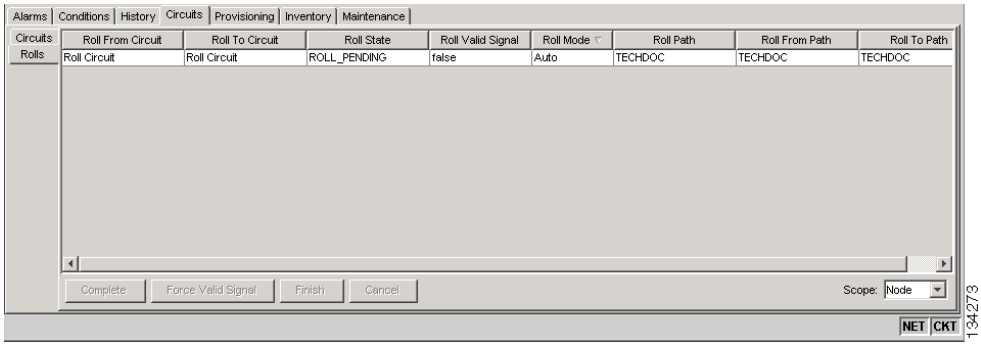
7.13 Bridge and Roll

The CTC Bridge and Roll wizard reroutes live traffic without interrupting service. The bridge process takes traffic from a designated "roll from" facility and establishes a cross-connect to the designated "roll to" facility. When the bridged signal at the receiving end point is verified, the roll process creates a new cross-connect to receive the new signal. When the roll completes, the original cross-connects are released. You can use the bridge and roll feature for maintenance functions such as card or facility replacement, or for load balancing. You can perform a bridge and roll on the following ONS platforms: ONS 15600, ONS 15454, ONS 15454 SDH, ONS 15327, and ONS 15310.

7.13.1 Rolls Window

The Rolls window lists information about a rolled circuit before the roll process is complete. You can access the Rolls window by clicking the Circuits > Rolls tabs in either network or node view. Figure 7-7 shows the Rolls window.

Figure 7-7 Rolls Window



The Rolls window information includes:

- Roll From Circuit—The circuit with connections that will no longer be used when the roll process is complete.
- Roll To Circuit—The circuit that will carry the traffic when the roll process is complete. The Roll To Circuit is the same as the Roll From Circuit if a single circuit is involved in a roll.
- Roll State—The roll status; see the "7.13.2 Roll Status" section on page 7-23 for information.
- Roll Valid Signal—If the Roll Valid Signal status is true, a valid signal was found on the new port. If the Roll Valid Signal status is false, a valid signal was not found. It is not possible to get a true Roll Valid Signal status for a one-way destination roll.
- Roll Mode—The mode indicates whether the roll is automatic or manual.

  CTC implements a roll mode at the circuit level. TL1 implements a roll mode at the cross-connect level. If a single roll is performed, CTC and TL1 behave the same. If a dual roll is performed, the roll mode specified in CTC might be different than the roll mode retrieved in TL1. For example, if you select Automatic, CTC coordinates the two rolls to minimize possible traffic hits by using the Manual mode behind the scenes. When both rolls have a good signal, CTC signals the nodes to complete the roll.

  – Automatic—When a valid signal is received on the new path, CTC completes the roll on the node automatically. One-way source rolls are always automatic.

  - Manual—You must complete a manual roll after a valid signal is received. One-way destination rolls are always manual.
- Roll Path—The fixed point of the roll object.
- Roll From Path— The old path that is being rerouted.
- Roll To Path—The new path where the Roll From Path is rerouted.
- Complete—Completes a manual roll after a valid signal is received. You can complete a manual roll if it is in a ROLL_PENDING status and you have not yet completed the roll or have not cancelled its sibling roll.
- Force Valid Signal—Forces a roll onto the Roll To Circuit destination without a valid signal. If you choose Force Valid Signal, traffic on the circuit that is involved in the roll will be dropped once the roll is completed.
- Finish—Completes the circuit processing of both manual and automatic rolls and changes the circuit status from ROLL_PENDING to DISCOVERED. After a roll, the Finish button also removes any cross-connects that are no longer used from the Roll From Circuit field.
- Cancel—Cancels the roll process. When the roll mode is Manual, cancel roll is only allowed before you click the Complete button. When the roll mode is Auto, cancel roll is only allowed before a good signal is detected by the node or before you click the Force Valid Signal button.

7.13.2 Roll Status

Table 7-9 lists the roll statuses. You can only reroute circuits that have a DISCOVERED status. (See Table 7-2 on page 7-6 for a list of circuit statuses.) You cannot reroute circuits that are in the ROLL_PENDING status.

Table 7-9 Roll Statuses

State	Description
ROLL_PENDING	The roll is awaiting completion or cancellation.
ROLL_COMPLETED	The roll is complete. Click the Finish button.
ROLL_CANCELLED	The roll has been canceled.
TL1_ROLL	A TL1 roll was initiated. **Note** If a roll is created using TL1, a CTC user cannot complete or cancel the roll. Also, if a roll is created using CTC, a TL1 user cannot complete or cancel the roll. You must use the same interface to complete or change a roll.
INCOMPLETE	This state appears when the underlying circuit becomes incomplete. To correct this state, you must fix the underlying circuit problem before the roll state will change. For example, a circuit traveling on Nodes A, B, and C can become INCOMPLETE if Node B is rebooted. The cross connect information is lost on Node B during a reboot. The Roll State on Nodes A and C will change to INCOMPLETE.

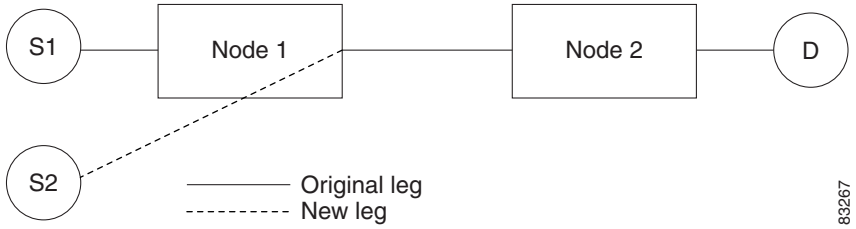
7.13.3 Single and Dual Rolls

Circuits have an additional layer of roll types: single and dual. A single roll on a circuit is a roll on one of its cross-connects. Use a single roll to:

- Change either the source or destination of a selected circuit (Figure 7-8 and Figure 7-9, respectively).
- Roll a segment of the circuit onto another chosen circuit (Figure 7-10 on page 7-24). This roll also results in a new destination or a new source.

In Figure 7-8, you can select any available STS on Node 1 for a new source.

Figure 7-8 Single Source Roll



In Figure 7-9, you can select any available STS on Node 2 for a new destination.

Figure 7-9 Single Destination Roll

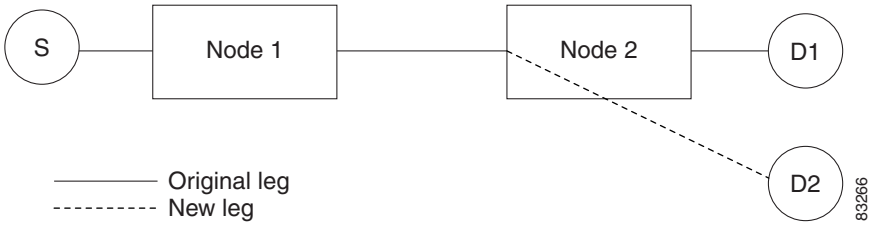


Figure 7-10 shows one circuit rolling onto another circuit at the destination. The new circuit has cross-connects on Node 1, Node 3, and Node 4. CTC deletes the cross-connect on Node 2 after the roll.

Figure 7-10 Single Roll from One Circuit to Another Circuit (Destination Changes)

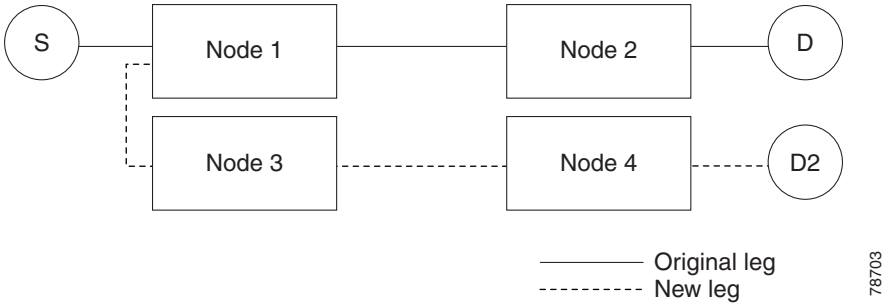
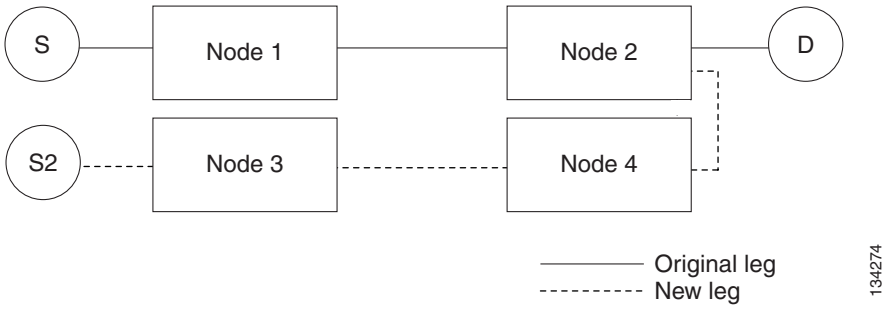


Figure 7-11 shows one circuit rolling onto another circuit at the source.

Figure 7-11 Single Roll from One Circuit to Another Circuit (Source Changes)



Note Create a Roll To Circuit before rolling a circuit with the source on Node 3 and the destination on Node 4.

A dual roll involves two cross-connects. It allows you to reroute intermediate segments of a circuit, but keep the original source and destination. If the new segments require new cross-connects, use the Bridge and Roll wizard or create a new circuit and then perform a roll.

Caution If you are using TL1 to perform rolls, this interface can only be used for single rolls. Dual rolls require the network-level view that only CTC or CTM provide.

Dual rolls have several constraints:

- You must complete or cancel both cross-connects rolled in a dual roll. You cannot complete one roll and cancel the other roll.
- When a Roll To circuit is involved in the dual roll, the first roll must roll onto the source of the Roll To circuit and the second roll must roll onto the destination of the Roll To circuit.

Figure 7-12 illustrates a dual roll on the same circuit.

Figure 7-12 Dual Roll to Reroute a Link

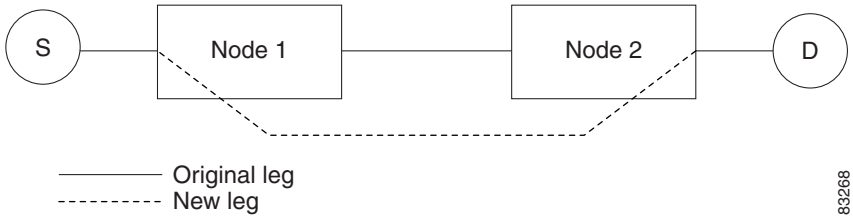
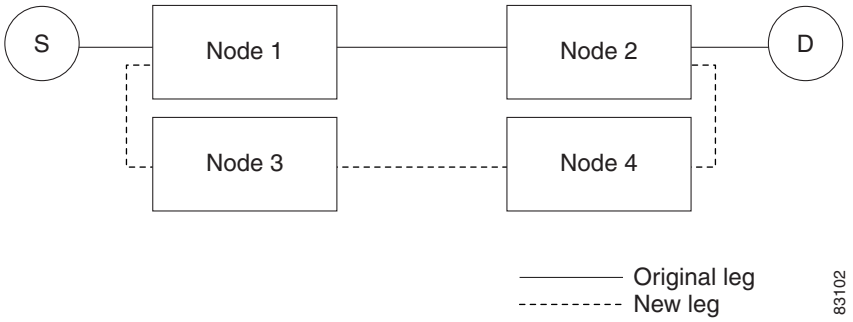


Figure 7-13 illustrates a dual roll involving two circuits.

Figure 7-13 Dual Roll to Reroute to a Different Node



Note If a new segment is created on Nodes 3 and 4 using the Bridge and Roll wizard, the created circuit has the same name as the original circuit with the suffix _ROLL**. The circuit source is on Node 3 and the circuit destination is on Node 4.

7.13.4 Two Circuit Bridge and Roll

When using the bridge and roll feature to reroute traffic using two circuits, the following constraints apply:

- DCC must be enabled on the circuits involved in a roll before roll creation.
- A maximum of two rolls can exist between any two circuits.
- If two rolls are involved between two circuits, both rolls must be on the original circuit. The second circuit should not carry live traffic. The two rolls loop from the second circuit back to the original circuit. The roll mode of the two rolls must be identical (either automatic or manual).
- If a single roll exists on a circuit, you must roll the connection onto the source or the destination of the second circuit and not an intermediate node in the circuit.

7.13.5 Protected Circuits

CTC allows you to roll the working or protect path regardless of which path is active. You can upgrade an unprotected circuit to a fully protected circuit or downgrade a fully protected circuit to an unprotected circuit with the exception of a path protection circuit. When using bridge and roll on path protection circuits, you can roll the source or destination or both path selectors in a dual roll. However, you cannot roll a single path selector.

7.14 Merged Circuits

A circuit merge combines a single selected circuit with one or more circuits. You can merge CTC-created circuits and TL1-created circuits. To merge circuits, you choose a circuit in the CTC Circuits window and the circuits that you want to merge with the chosen (master) circuit on the Merge tab in the Edit Circuit window. The Merge tab shows only the circuits that are available for merging with the master circuit:

- Circuit cross-connects must create a single, contiguous path.

- Circuits types must be a compatible.
- Circuit directions must be compatible. You can merge a one-way and a two-way circuit, but not two one-way circuits in opposing directions.
- Circuit sizes must be identical.
- Circuit end points must send or receive the same framing format.
- The merged circuits must become a DISCOVERED circuit.

If all connections from the master circuit and all connections from the merged circuits align to form one complete circuit, the merge is successful. If all connections from the master circuit and some, but not all, connections from the other circuits align to form a single complete circuit, CTC notifies you and gives you the chance to cancel the merge process. If you choose to continue, the aligned connections merge successfully into the master circuit, and unaligned connections remain in the original circuits. All connections in the completed master circuit use the original master circuit name.

All connections from the master circuit and at least one connection from the other selected circuits must be used in the resulting circuit for the merge to succeed. If a merge fails, the master circuit and all other circuits remain unchanged. When the circuit merge completes successfully, the resulting circuit retains the name of the master circuit.

7.15 Reconfigured Circuits

You can reconfigure multiple circuits, which is typically necessary when a large number of circuits are in the PARTIAL status. When you reconfigure multiple circuits, the selected circuits can be any combination of DISCOVERED, PARTIAL, DISCOVERED_TL1, and PARTIAL_TL1 circuits. You can reconfigure tunnels, CTC-created circuits, and TL1-created circuits. The Reconfigure command maintains the names of the original cross-connects.

Use the CTC Tools > Circuits > Reconfigure Circuits command to reconfigure selected circuits. During reconfiguration, CTC reassembles all connections of the selected circuits into circuits based on path size, direction, and alignment. Some circuits might merge and others might split into multiple circuits. If the resulting circuit is a valid circuit, it appears as a DISCOVERED circuit. Otherwise, the circuit appears as a PARTIAL or PARTIAL_TL1 circuit.

Note PARTIAL tunnel circuits do not split into multiple circuits during reconfiguration.

7.16 Server Trails

A server trail is a non-DCC link across a third-party network that connects two CTC network domains. A server trail allows circuit provisioning when no DCC is available. You can create server trails between any two optical or DS-3 ports. The end ports of a server trail can be different types. Server trails are not allowed on DCC-enabled ports.

The server trail link is bidirectional and can be VT1.5, VT2, STS1, STS-3c, or STS-12c; you cannot upgrade an existing server trail to another size. A server trail link can be one of the following protection types: Preemptible, Unprotected, and Fully Protected. The server trail protection type determines the protection type for any circuits that traverse it. PCA circuits will use server trails with the Preemptible attribute.

When creating circuits or VCATs, you can choose a server trail link during manual circuit routing. CTC may also route circuits over server trail links during automatic routing. VCAT common-fiber automatic routing is not supported.

SONET Topologies and Upgrades

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter explains Cisco ONS 15600 SONET topologies and upgrades. To provision topologies, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 8.1 Overview, page 8-1
- 8.2 Point-to-Point and Linear ADM Configurations, page 8-2
- 8.3 Bidirectional Line Switched Rings, page 8-2
- 8.4 Path-Protected Mesh Networks, page 8-11
- 8.5 In-Service Topology Upgrades, page 8-13

8.1 Overview

The ONS 15600 usually operates as a hub node in networks that include ONS 15454s, ONS 15327s, and ONS 15310-CLs. Single nodes are installed at geographic locations where several ONS SONET topologies converge. A single ONS 15600 node might be a part of several ONS SONET rings/networks.

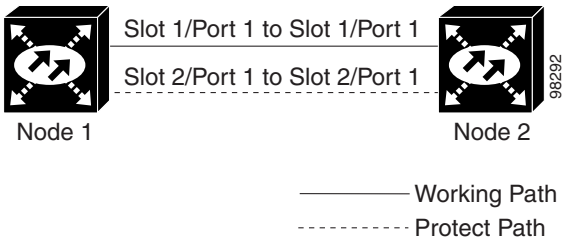
To avoid errors during network configuration, Cisco recommends that you draw the complete ONS SONET network topology on paper (or electronically) before you begin the physical implementation. A sketch ensures that you have adequate slots, cards, and fibers to complete the topology.

8.2 Point-to-Point and Linear ADM Configurations

You can configure ONS 15600s as a line of add/drop multiplexers (ADMs) by configuring one OC-N port as the working path and a second port as the protect path. Unlike rings, point-to-point (two node configurations) and linear (three node configurations) ADMs require that the OC-N ports at each node are in 1+1 protection to ensure that a break to the working path automatically routes traffic to the protect path.

Figure 8-1 shows two ONS 15600 nodes in a point-to-point ADM configuration. Working traffic flows from Slot 1/Port 1 at Node 1 to Slot 1/Port 1 at Node 2. You create the protect path by creating a 1+1 configuration with Slot 1/Port 1 and Slot 2/Port 1 at Nodes 1 and 2.

Figure 8-1 Point-to-Point ADM Configuration



8.3 Bidirectional Line Switched Rings

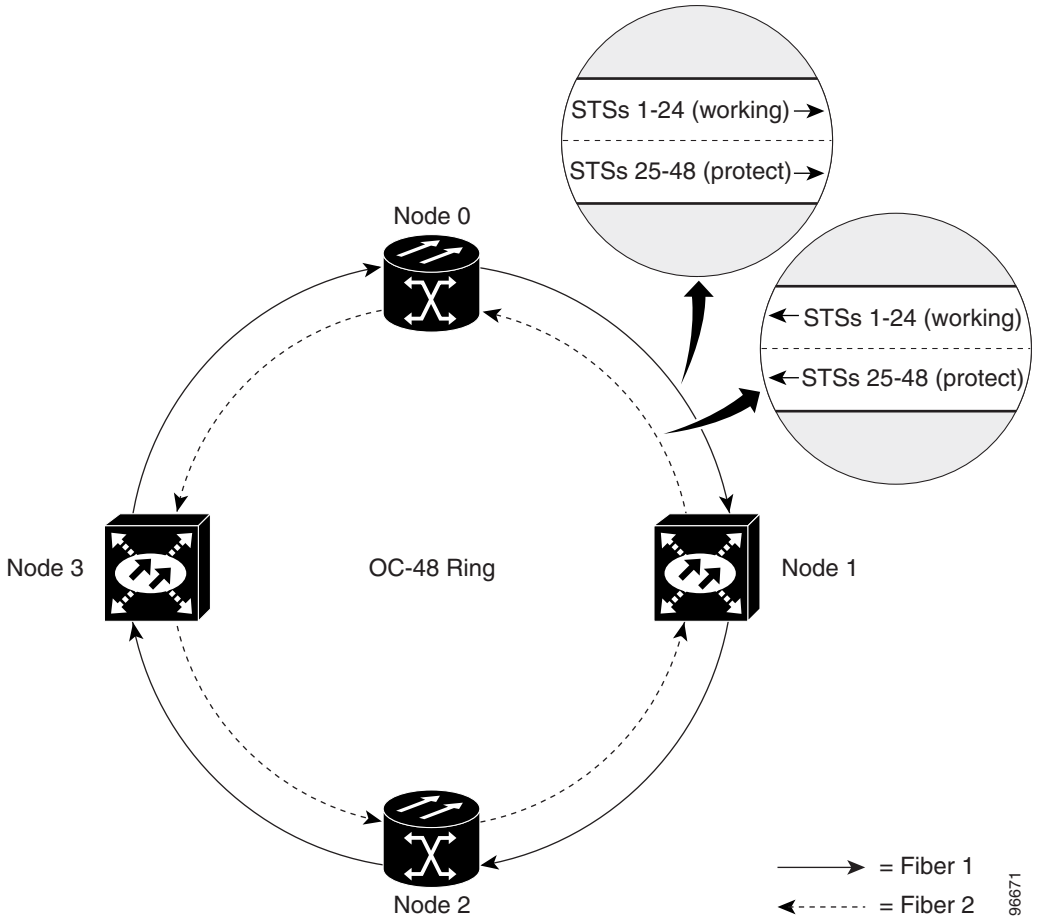
The ONS 15600 can support up to 32 bidirectional line switched rings (BLSRs). Eight four-fiber BLSR rings can be supported if all ports are OC-192. Because the working and protect bandwidths must be equal, you can create only OC-48 or OC-192 BLSRs. For information about BLSR protection channels, see the "7.7 Protection Channel Access Circuits" section on page 7-15.

Note For best performance, BLSRs should have one LAN connection for every ten nodes in the BLSR.

8.3.1 Two-Fiber BLSRs

In two-fiber BLSRs, each fiber is divided into working and protect bandwidths. For example, in an OC-48 BLSR, STSs 1 to 24 carry the working traffic, and STSs 25 to 48 are reserved for protection (Figure 8-2). Working traffic (STSs 1 to 24) travels in one direction on one fiber and in the opposite direction on the second fiber. Cisco Transport Controller (CTC) circuit routing routines calculate the shortest path for circuits based on many factors, including user requirements, traffic patterns, and distance. For example, in Figure 8-2, circuits going from Node 0 to Node 1 will typically travel on Fiber 1, unless that fiber is full, in which case circuits will be routed to Fiber 2 through Node 3 and Node 2. Traffic from Node 0 to Node 2 (or Node 1 to Node 3) can be routed on either fiber, depending on circuit provisioning requirements and traffic loads.

Figure 8-2 Four-Node, Two-Fiber BLSR



The SONET K1, K2, and K3 bytes carry the information that governs BLSR protection switches. Each BLSR node monitors the K bytes to determine when to switch the SONET signal to an alternate physical path. The K bytes communicate failure conditions and actions taken between nodes in the ring.

If a break occurs on one fiber, working traffic targeted for a node beyond the break switches to the protect bandwidth on the second fiber. The traffic travels in a reverse direction on the protect bandwidth until it reaches its destination node. At that point, traffic is switched back to the working bandwidth.

Figure 8-3 shows a traffic pattern sample on a four-node, two-fiber BLSR.

Figure 8-3 Four-Node, Two-Fiber BLSR Traffic Pattern Sample

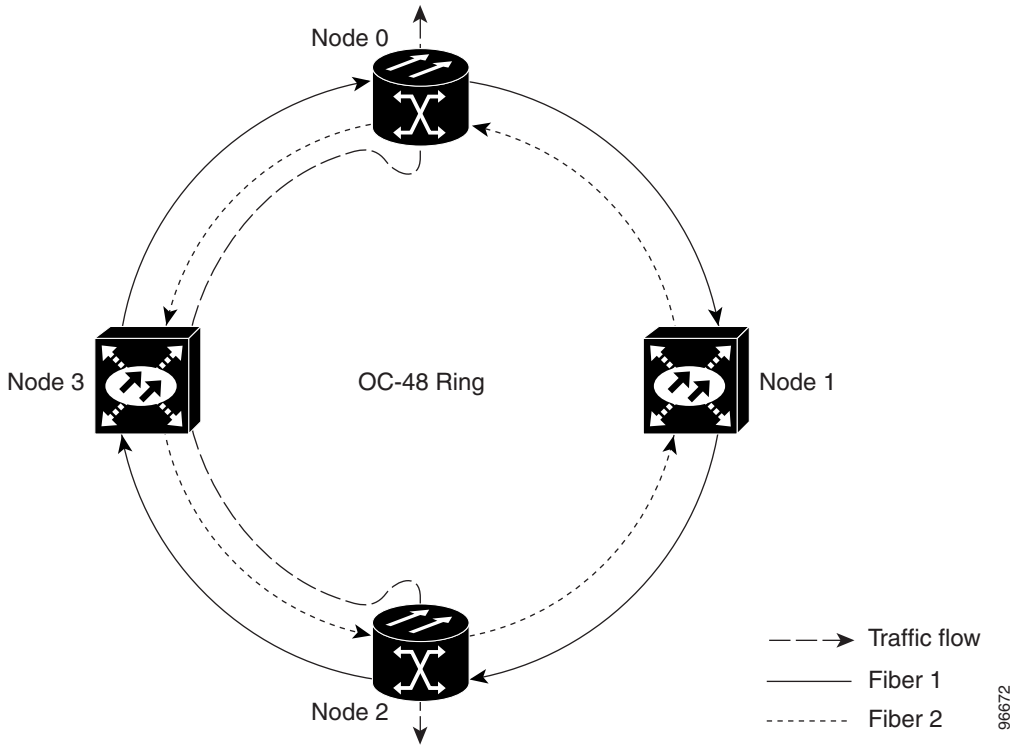
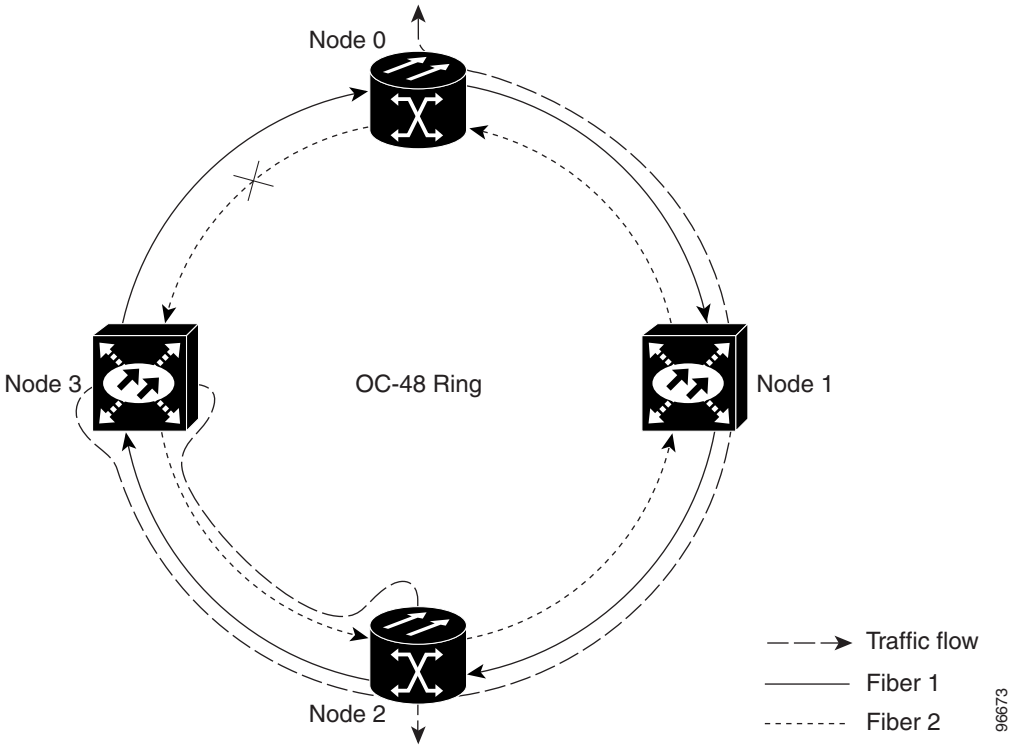


Figure 8-4 shows how traffic is rerouted following a line break between Node 0 and Node 3.

- All circuits originating on Node 0 that carried traffic to Node 2 on Fiber 2 are switched to the protect bandwidth of Fiber 1. For example, a circuit carrying traffic on STS-1 on Fiber 2 is switched to STS-25 on Fiber 1. A circuit carried on STS-2 on Fiber 2 is switched to STS-26 on Fiber 1. Fiber 1 carries the circuit to Node 3 (the original routing destination). Node 3 switches the circuit back to STS-1 on Fiber 2 where it is routed to Node 2 on STS-1.
- Circuits originating on Node 2 that normally carry traffic to Node 0 on Fiber 1 switch to the protect bandwidth of Fiber 2 at Node 3. For example, a circuit carrying traffic on STS-2 on Fiber 1 switches to STS-26 on Fiber 2. Fiber 2 carries the circuit to Node 0 where the circuit switches back to STS-2 on Fiber 1 and is then dropped to its destination.

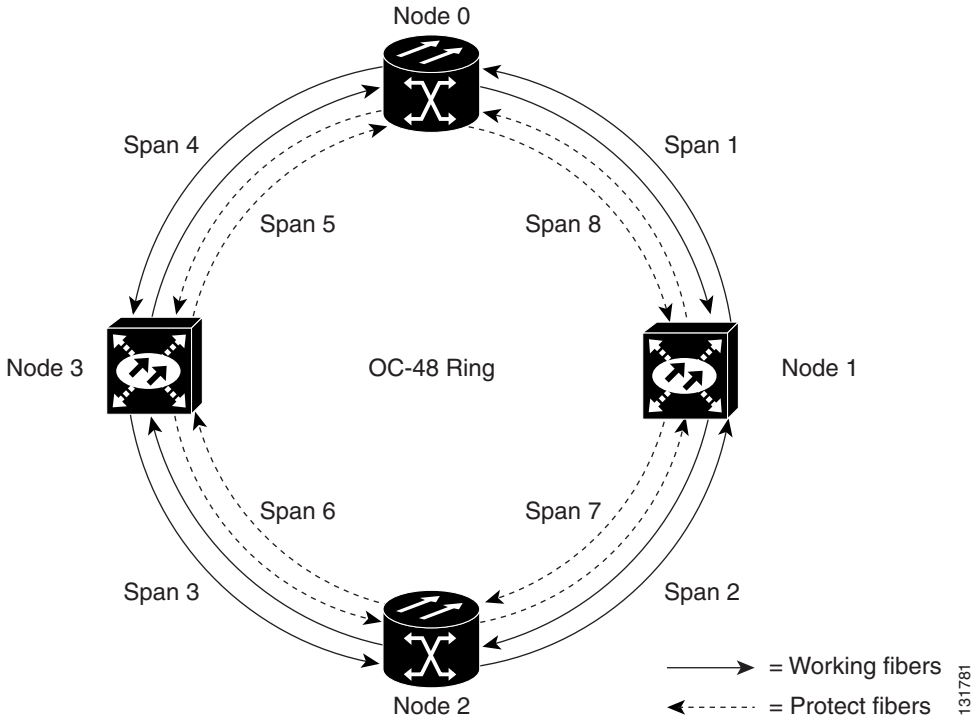
Figure 8-4 Four-Node, Two-Fiber BLSR Traffic Pattern Following Line Break



8.3.2 Four-Fiber BLSRs

Four-fiber BLSRs double the bandwidth of two-fiber BLSRs. Because they allow span switching as well as ring switching, four-fiber BLSRs increase the reliability and flexibility of traffic protection. Two fibers are allocated for working traffic and two fibers for protection, as shown in Figure 8-5. To implement a four-fiber BLSR, you can install either two or four OC-48 or OC-192 cards at each BLSR node, or a single ASAP card at each node. (Each ASAP card provides up to sixteen OC-48 ports or four OC-192 ports. Refer to the "2.8 ASAP Card" section on page 2-19 for more information.)

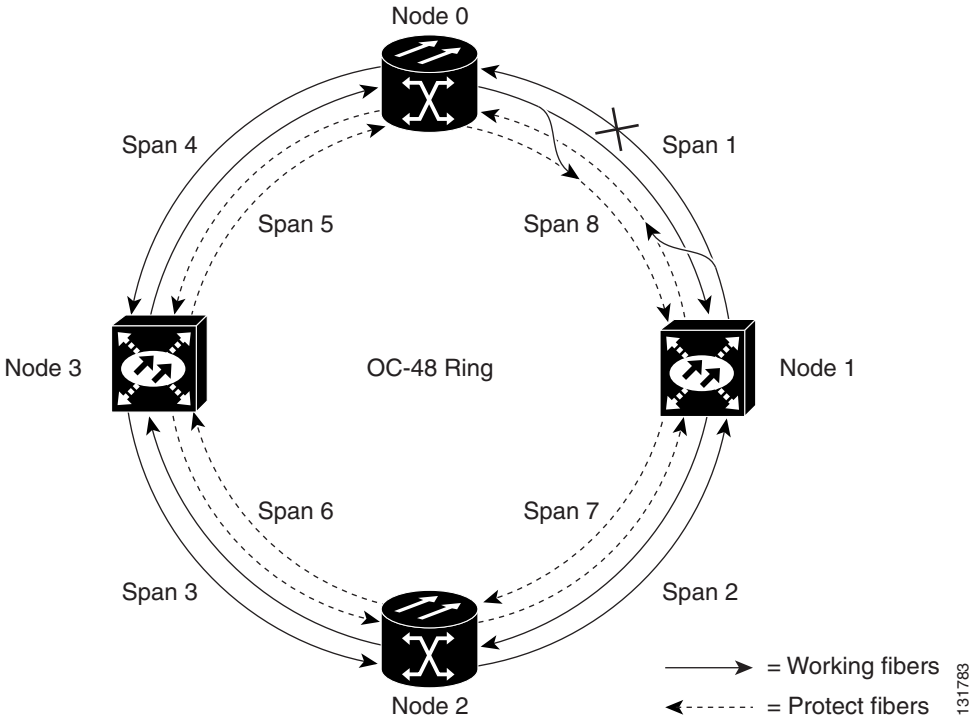
Figure 8-5 Four-Node, Four-Fiber BLSR



Four-fiber BLSRs provide span and ring switching:

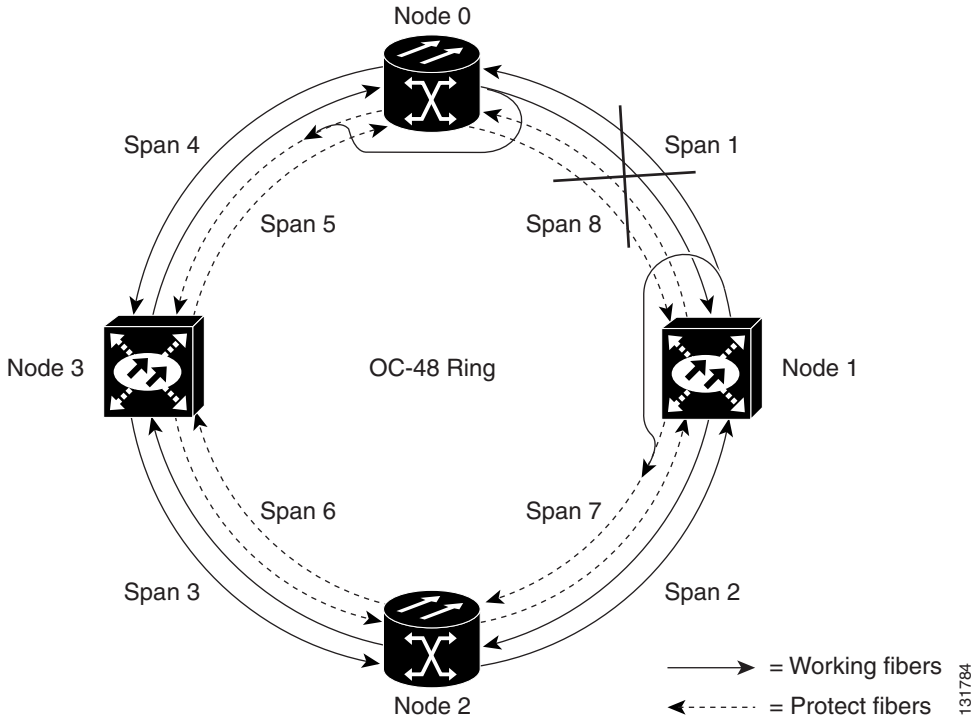
- Span switching (Figure 8-6 on page 8-7) occurs when a working span fails. Traffic switches to the protect fibers between the nodes (Node 0 and Node 1 in the example in Figure 8-6) and then returns to the working fibers. Multiple span switches can occur at the same time.

Figure 8-6 Four-Fiber BLSR Span Switch



- Ring switching (Figure 8-7) occurs when a span switch cannot recover traffic, such as when both the working and protect fibers fail on the same span. In a ring switch, traffic is routed to the protect fibers throughout the full ring.

Figure 8-7 Four-Fiber BLSR Ring Switch



8.3.3 BLSR Bandwidth

BLSR nodes can terminate traffic coming from either side of the ring. Therefore, BLSRs are suited for distributed node-to-node traffic applications such as interoffice networks and access networks.

BLSRs allow bandwidth to be reused around the ring and can carry more traffic than a network with traffic flowing through one central hub. BLSRs can also carry more traffic than a path protection operating at the same OC-N rate. Table 8-1 shows the bidirectional bandwidth capacities of two-fiber BLSRs. The capacity is the OC-N rate divided by two, multiplied by the number of nodes in the ring minus the number of pass-through STS-1 circuits.

Table 8-1 Two-Fiber BLSR Capacity

OC Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
OC-48	STS 1-24	STS 25-48	24 x N[1] – PT[2]
OC-192	STS 1-96	STS 97-192	96 x N – PT

1. N equals the number of ONS 15600 nodes configured as BLSR nodes.
2. PT equals the number of STS-1 circuits passed through ONS 15600 nodes in the ring (capacity can vary depending on the traffic pattern).

Table 8-2 shows the bidirectional bandwidth capacities of four-fiber BLSRs.

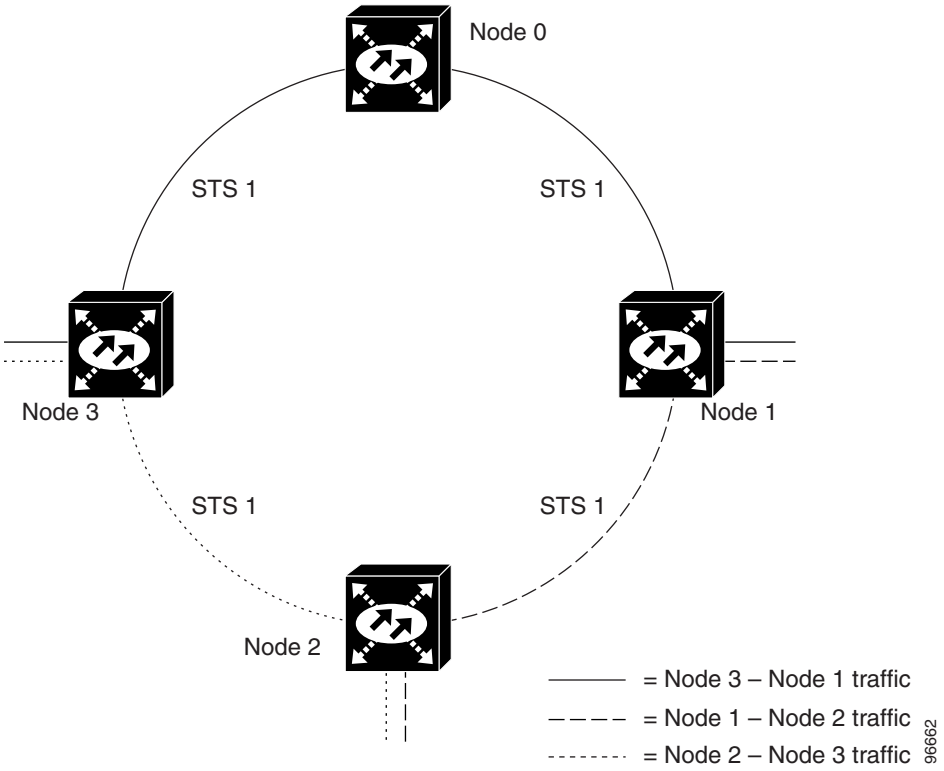
Table 8-2 Four-Fiber BLSR Capacity

OC Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
OC-48	STS 1-48 (Fiber 1)	STS 1-48 (Fiber 2)	48 x N[1] – PT[2]
OC-192	STS 1-192 (Fiber 1)	STS 1-192 (Fiber 2)	192 x N – PT

1. N equals the number of ONS 15600 nodes configured as BLSR nodes.
2. PT equals the number of STS-1 circuits passed through ONS 15600 nodes in the ring (capacity can vary depending on the traffic pattern).

Figure 8-8 shows an example of BLSR bandwidth reuse. The same STS carries three different traffic sets simultaneously on different spans around the ring: one set from Node 3 to Node 1, another set from Node 1 to Node 2, and another set from Node 2 to Node 3.

Figure 8-8 BLSR Bandwidth Reuse

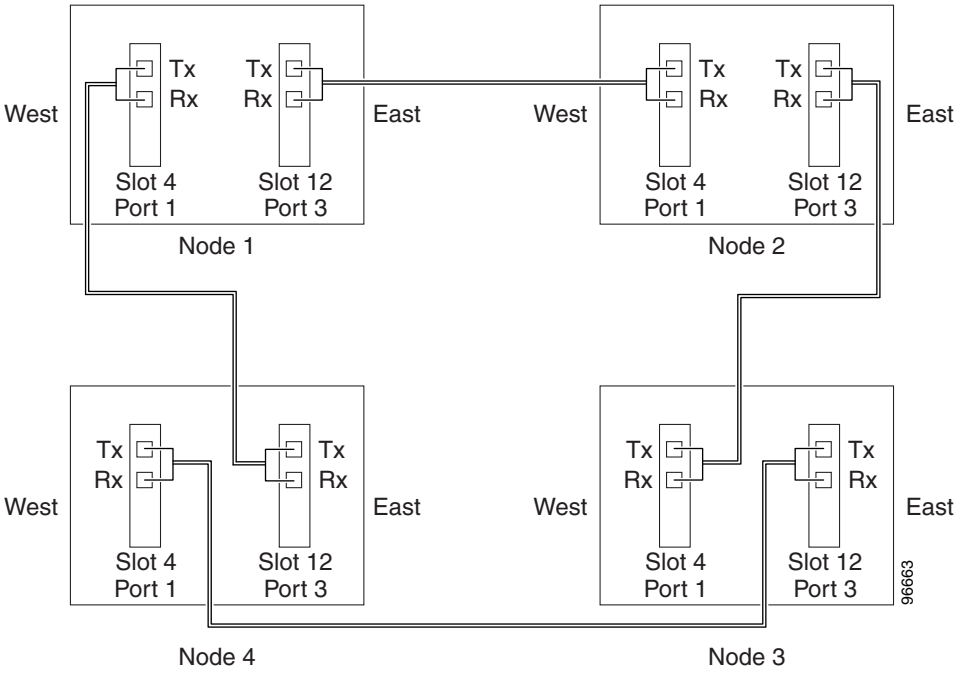


8.3.4 BLSR Fiber Connections

Plan your fiber connections and use the same plan for all BLSR nodes. For example, make the east port the farthest slot to the right and the west port the farthest slot to the left. Plug fiber connected to an east port at one node into the west port on an adjacent node. Figure 8-9 shows fiber connections for a two-fiber BLSR with trunk (span) ports in Slot 4 (west) and Slot 12 (east). Refer to the *Cisco ONS 15600 Procedure Guide* for fiber connection procedures.

Note Always plug the transmit (Tx) connector of an OC-N port at one node into the receive (Rx) connector of an OC-N port at the adjacent node. Cards display an SF LED when Tx and Rx connections are mismatched.

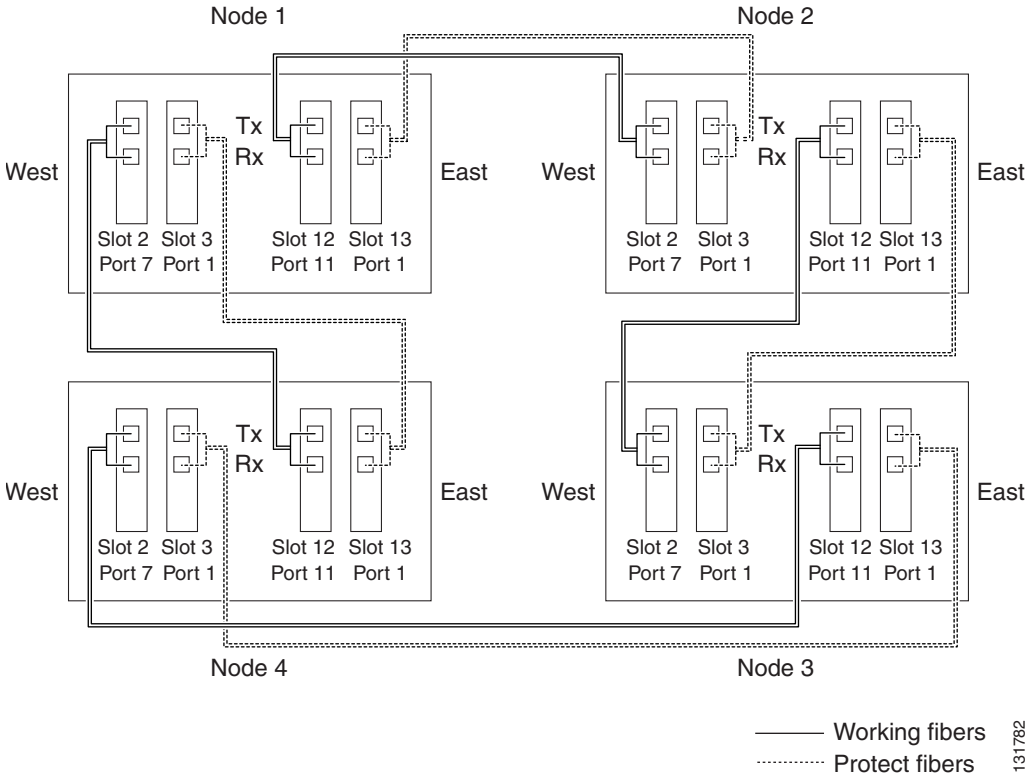
Figure 8-9 Connecting Fiber to a Four-Node, Two-Fiber BLSR



For four-fiber BLSRs, use the same east-west connection pattern for the working and protect fibers. Do not mix working and protect port connections. The BLSR does not function if working and protect ports are interconnected.

Figure 8-10 shows fiber connections for a four-fiber BLSR. Slot 2/Port 7 (west) and Slot 12/Port 11 (east) carry the working traffic. Slot 3/Port 1 (west) and Slot 13/Port 1 (east) carry the protect traffic.

Figure 8-10 Connecting Fiber to a Four-Node, Four-Fiber BLSR

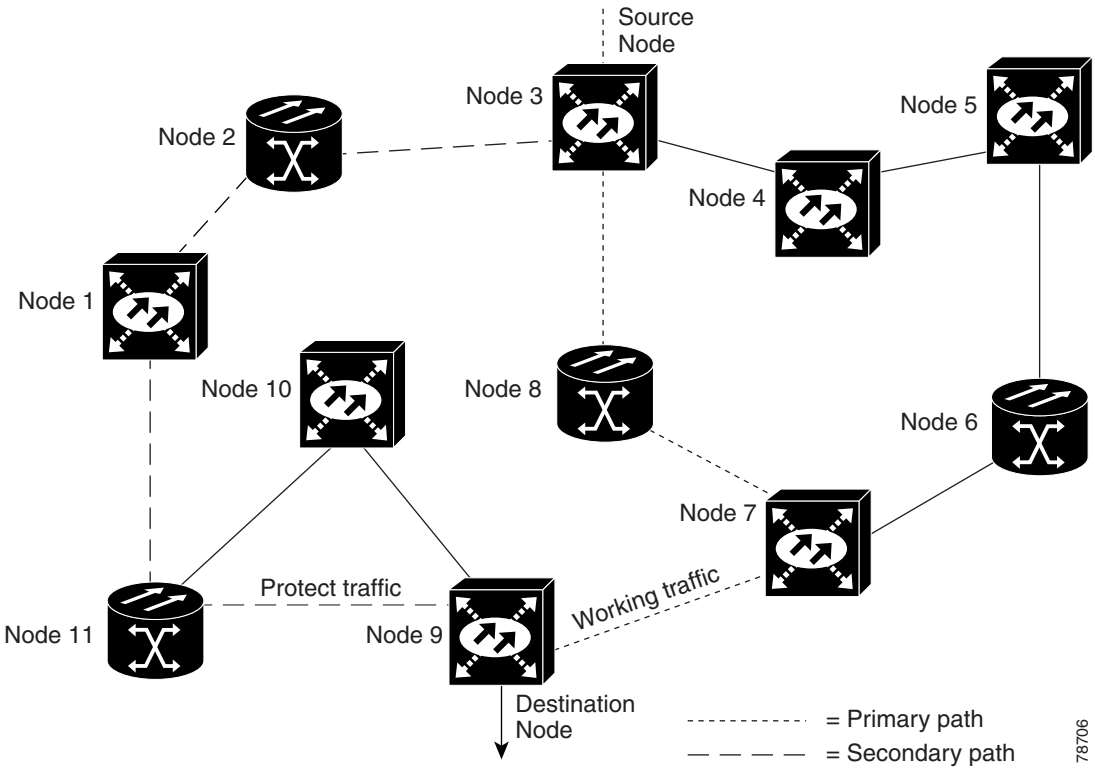


8.4 Path-Protected Mesh Networks

In addition to single BLSRs, path protection configurations, and ADMs, you can extend ONS 15600 traffic protection by creating path-protected mesh networks (PPMNs). PPMNs include multiple ONS 15600 SONET topologies and extend the protection provided by a single path protection to the meshed architecture of several interconnecting rings. In a PPMN, circuits travel diverse paths through a network of single or multiple meshed rings. When you create circuits, CTC automatically routes circuits across the PPMN, or you can manually route them. You can also choose levels of circuit protection. For example, if you choose full protection, CTC creates an alternate route for the circuit in addition to the main route. The second route follows a unique path through the network between the source and destination and sets up a second set of cross-connections.

For example, in Figure 8-11, a circuit is created from Node 3 to Node 9. CTC determines that the shortest route between the two nodes passes through Node 8 and Node 7, shown by the dotted line, and automatically creates cross-connections at Nodes 3, 8, 7, and 9 to provide the primary circuit path.

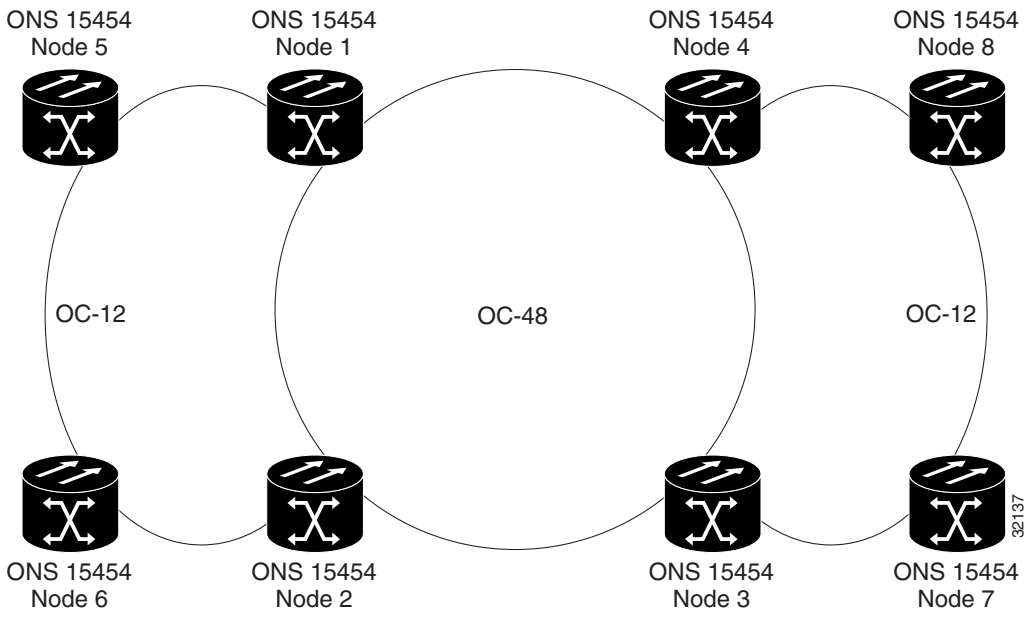
Figure 8-11 Path-Protected Mesh Network



If full protection is selected, CTC creates a second unique route between Nodes 3 and 9 that passes through Nodes 2, 1, and 11. Cross-connections are automatically created at Nodes, 3, 2, 1, 11, and 9, shown by the dashed line. If a failure occurs on the primary path, traffic switches to the second circuit path. In this example, Node 9 switches from the fiber from Node 7 to the fiber from Node 11 and service resumes. The switch occurs within 50 ms.

PPMN also allows spans of different SONET line rates to be mixed together in virtual rings. Figure 8-12 shows Nodes 1, 2, 3, and 4 in an OC-192 ring.

Figure 8-12 PPMN Virtual Ring



8.5 In-Service Topology Upgrades

Topology upgrades can be performed in-service to convert a live network to a different topology. An in-service topology upgrade is potentially service-affecting, and generally allows a traffic hit of 50 ms or less. Traffic might not be protected during the upgrade. The following in-service topology upgrades are supported:

- Point-to-point or linear ADM to two-fiber BLSR
- Two-fiber BLSR to four-fiber BLSR
- Node addition or removal from an existing topology

You can perform in-service topology upgrades irrespective of the service state of the involved cross-connects or circuits, however all circuits must have a DISCOVERED status.

ONS 15600 circuit types supported for in-service topology upgrades are:

- Synchronous transport signal (STS)
- Unidirectional and bidirectional
- Automatically routed and manually routed
- CTC-created and TL1-created
- Ethernet (unstitched)
- Multiple source and destination (both sources should be on one node and both drops on one node)

You cannot upgrade stitched Ethernet circuits during topology conversions. For in-service topology upgrade procedures, refer to the "Convert Network Configurations" chapter in the *Cisco ONS 15600 Procedure Guide*. For procedures to add or remove a node, refer to the "Add and Remove Nodes" chapter of the *Cisco ONS 15600 Procedure Guide*.

Note A database restore on all nodes in a topology returns converted circuits to their original topology.

Note Open-ended path protection and DRI configurations do not support in-service topology upgrades.

8.5.1 Point-to-Point or Linear ADM to Two-Fiber BLSR

A 1+1 point-to-point or linear ADM to two-fiber BLSR conversion is manual. You must remove the protect fibers from all nodes in the linear ADM and route them from the end node to the protect port on the other end node. In addition, you must delete the circuit paths that are located in the bandwidth that will become the protection portion of the two-fiber BLSR (for example, circuits in STS 25 or higher on an OC-48 BLSR) and recreate them in the appropriate bandwidth. Finally, you must provision the nodes as BLSR nodes.

8.5.2 Two-Fiber BLSR to Four-Fiber BLSR

CTC provides a wizard to convert two-fiber OC-48 or OC-192 BLSRs to four-fiber BLSRs. To convert the BLSR, you must install two OC-48 or OC-192 ports at each two-fiber BLSR node, then log into CTC and convert each node from two-fiber to four-fiber. The fibers that were divided into working and protect bandwidths for the two-fiber BLSR are now fully allocated for working BLSR traffic.

8.5.3 Add or Remove a Node from a Topology

You can add or remove a node from a linear ADM, BLSR, or path protection configuration. Adding or removing nodes from BLSRs is potentially service affecting, however adding and removing nodes from an existing 1+1 linear ADM or path protection configuration does not disrupt traffic. CTC provides a wizard for adding a node to a point-to-point or 1+1 linear ADM. This wizard is used when adding a node between two other nodes.

Management Network Connectivity

This chapter provides an overview of Cisco ONS 15600 data communications network (DCN) connectivity. Cisco optical network communication is based on IP, including communication between Cisco Transport Controller (CTC) computers and ONS 15600s, and communication among networked ONS 15600 nodes. The chapter provides scenarios showing ONS 15600s in common IP network configurations as well as information about provisionable patchcords, the IP routing table, external firewalls, and open gateway network element (GNE) networks.

Note This chapter does not provide a comprehensive explanation of IP networking concepts and procedures, nor does it provide IP addressing examples to meet all networked scenarios. For ONS 15600 networking setup instructions, refer to the "Turn Up a Node" chapter of the *Cisco ONS 15600 Procedure Guide*.

Although ONS 15600 DCN communication is based on IP, ONS 15600s can be networked to equipment that is based on the Open System Interconnection (OSI) protocol suites. This chapter describes the ONS 15600 OSI implementation and provides scenarios that show how ONS 15600 can be networked within a mixed IP and OSI environment.

Chapter topics include:

- 9.1 IP Networking Overview, page 9-1
- 9.2 ONS 15600 IP Addressing Scenarios, page 9-2
- 9.3 Provisionable Patchcords, page 9-19
- 9.4 Routing Table, page 9-20
- 9.5 External Firewalls, page 9-22
- 9.6 Open GNE, page 9-24
- 9.7 TCP/IP and OSI Networking, page 9-26

Note To set up ONS 15600s within an IP network, you must work with a LAN administrator or other individual at your site who has IP networking training and experience.

9.1 IP Networking Overview

ONS 15600s can be connected in many different ways within an IP environment:

- You can connect ONS 15600 nodes and LANs through direct connections or a router.

- IP subnetting can create ONS 15600 node groups, which allow you to provision nodes in a network that are not connected using the data communications channel (DCC).
- Different IP functions and protocols allow you to achieve specific network goals. For example, Proxy Address Resolution Protocol (ARP) enables one LAN-connected ONS 15600 to serve as a gateway for ONS 15600s that are not connected to the LAN.
- You can create static routes to enable connections among multiple CTC sessions with ONS 15600s that reside on the same subnet but have different destination IP addresses.
- If ONS 15600s are connected to Open Shortest Path First (OSPF) networks, ONS 15600 network information is automatically communicated across multiple LANs and WANs.

9.2 ONS 15600 IP Addressing Scenarios

ONS 15600 IP addressing generally has eight common scenarios or configurations. Use the scenarios as building blocks for more complex network configurations. Table 9-1 provides a general list of items to check when setting up ONS 15600s in IP networks.

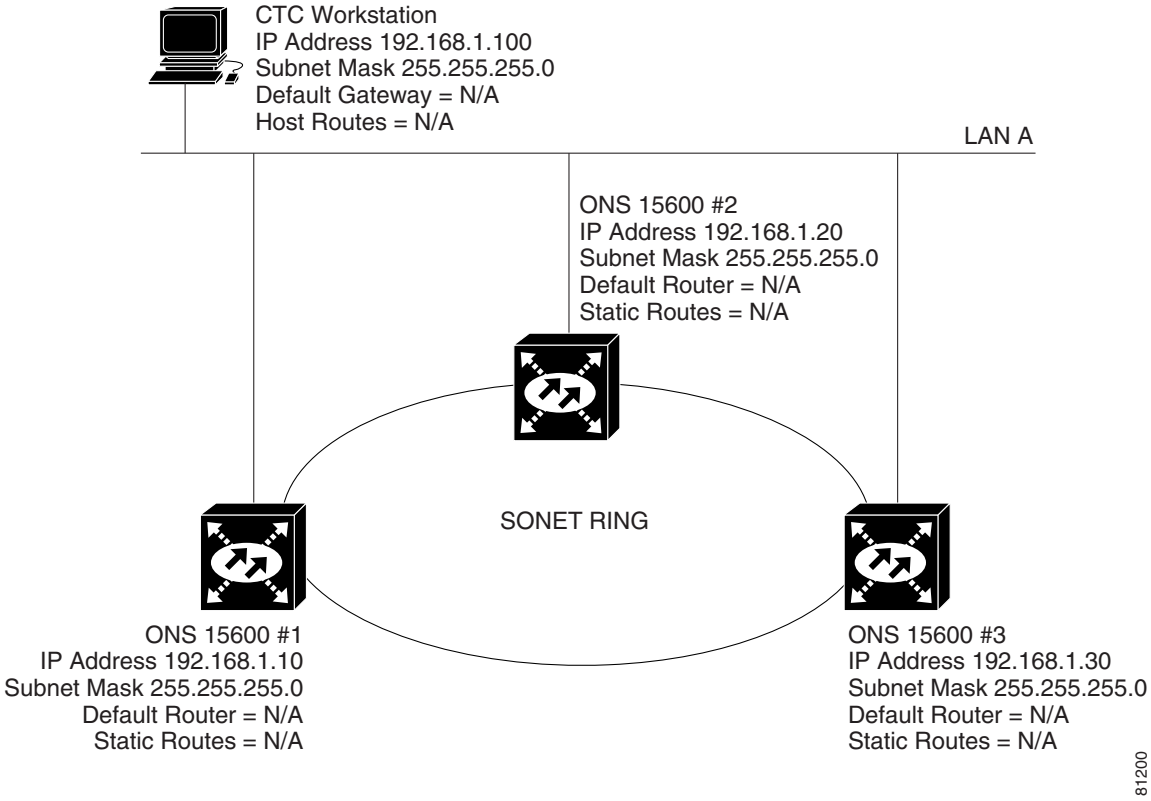
Table 9-1 General ONS 15600 IP Troubleshooting Checklist

Item	What to Check
Link integrity	Verify that link integrity exists between: • CTC computer and network hub/switch • ONS 15600s (backplane ports or active Timing and Shelf Controller [TSC] card port) and network hub/switch • Router ports and hub/switch ports
ONS 15600 hub/switch ports	If connectivity problems occur, set the hub or switch port that is connected to the ONS 15600 to 10 Mbps half-duplex.
Ping	Ping the node to test connections between computers and ONS 15600s.
IP addresses/subnet masks	Verify that ONS 15600 IP addresses and subnet masks are set up correctly.
Optical connectivity	Verify that ONS 15600 optical trunk ports are in service; DCC is enabled on each trunk port.

9.2.1 Scenario 1: CTC and ONS 15600s on the Same Subnet

Scenario 1 shows a basic ONS 15600 LAN configuration (Figure 9-1). The ONS 15600s and CTC computer reside on the same subnet. All ONS 15600s connect to LAN A, and all ONS 15600s have DCC connections.

Figure 9-1 Scenario 1: CTC and ONS 15600s on Same Subnet

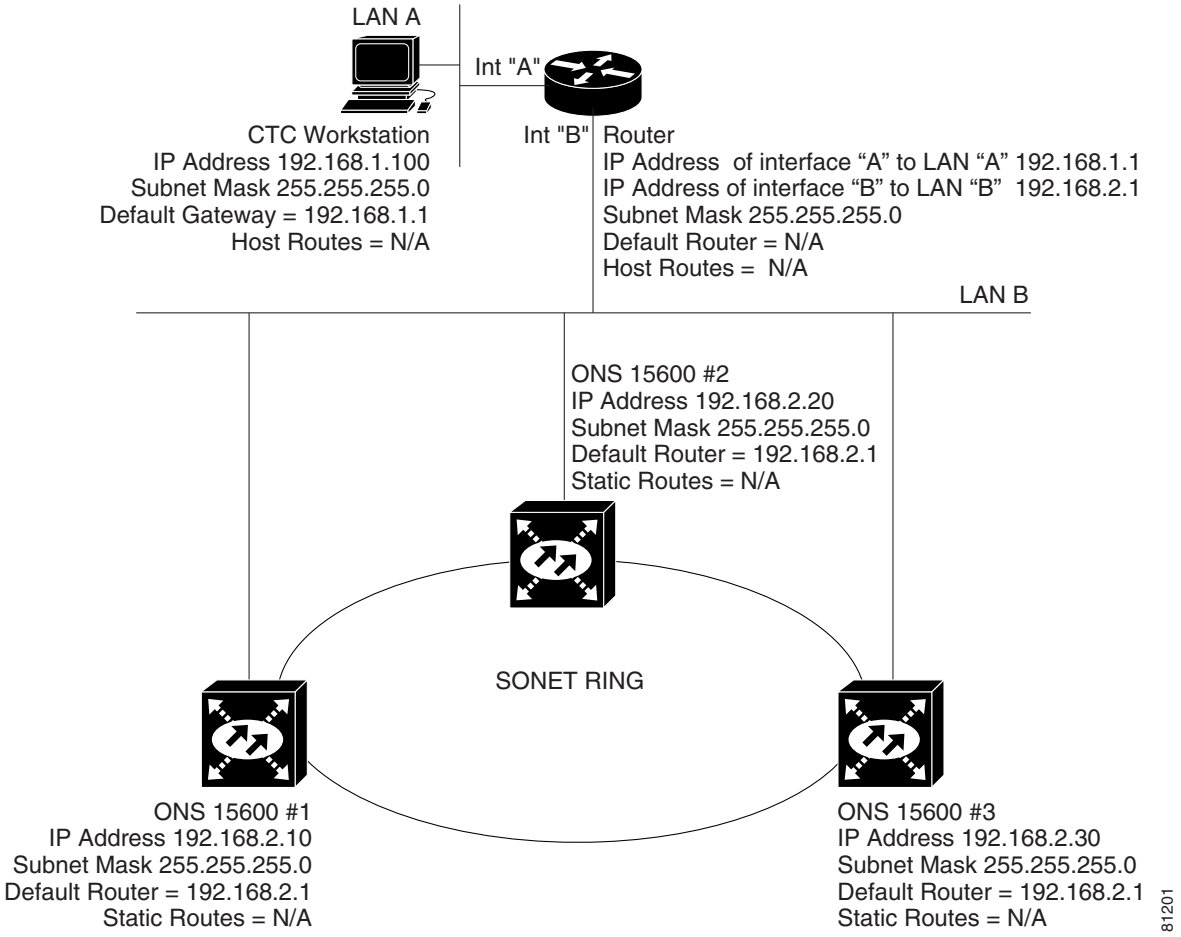


9.2.2 Scenario 2: CTC and ONS 15600s Connected to Router

In Scenario 2, the CTC computer resides on a subnet (192.168.1.0) and attaches to LAN A (Figure 9-2). The ONS 15600s reside on a different subnet (192.168.2.0) and attach to LAN B. A router connects LAN A to LAN B. The IP address of router interface A is set to LAN A (192.168.1.1), and the IP address of router interface B is set to LAN B (192.168.2.1).

On the CTC computer, the default gateway is set to router interface A. If the LAN uses Dynamic Host Configuration Protocol (DHCP), the default gateway and IP address are assigned automatically. In the Figure 9-2 example, a DHCP server is not available.

Figure 9-2 Scenario 2: CTC and ONS 15600s Connected to Router

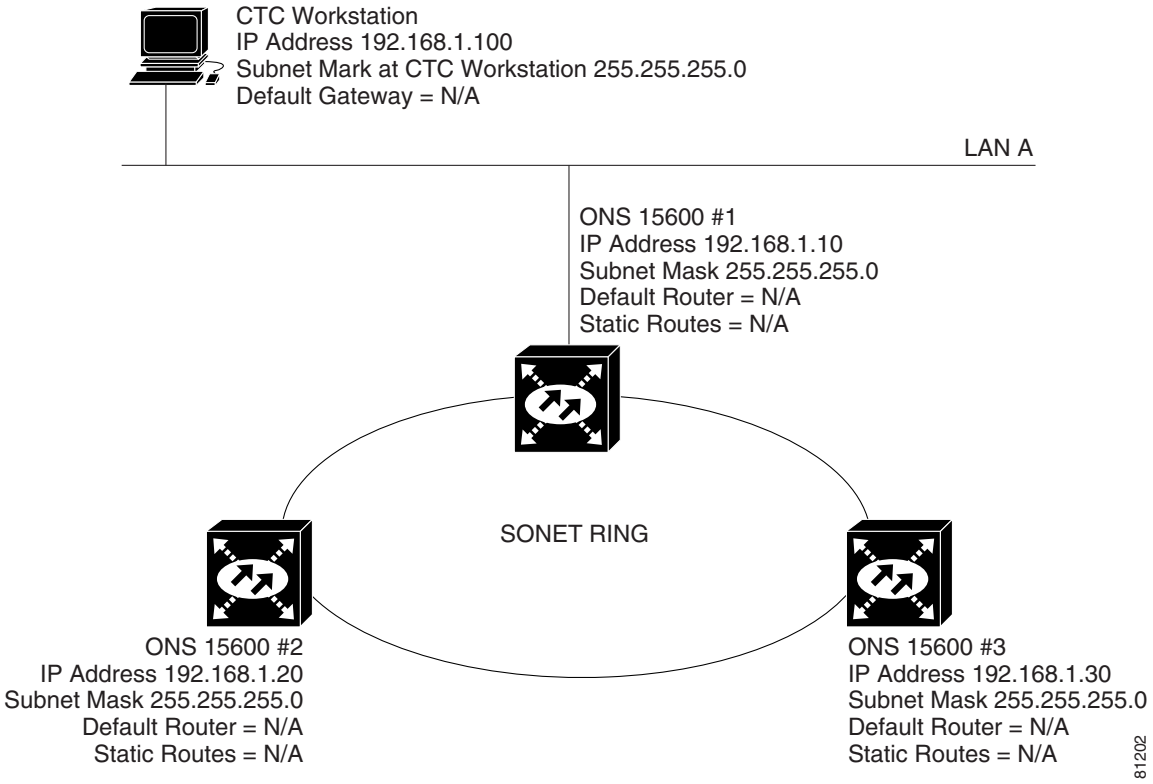


9.2.3 Scenario 3: Using Proxy ARP to Enable an ONS 15600 Gateway

Scenario 3 is similar to Scenario 1, but only one ONS 15600 (Node 1) connects to the LAN (Figure 9-3). Two ONS 15600s (Nodes 2 and 3) connect to Node1 through the SONET data communications channel (DCC). Because all three ONS 15600s are on the same subnet, Proxy ARP enables Node 1 to serve as a gateway for Nodes 2 and 3.

Note This scenario assumes that all CTC connections are to Node 1. If you connect a laptop to either Node 2 or Node 3, network partitioning will occur; neither the laptop or the CTC computer will be able to see all nodes. If you want laptops to connect directly to end network elements (ENEs), you will need to create static routes (refer to the "9.2.5 Scenario 5: Using Static Routes to Connect to LANs" section on page 9-6) or enable the ONS 15600 proxy server (see the "9.2.7 Scenario 7: Provisioning the ONS 15600 Proxy Server" section on page 9-11).

Figure 9-3 Scenario 3: Using Proxy ARP



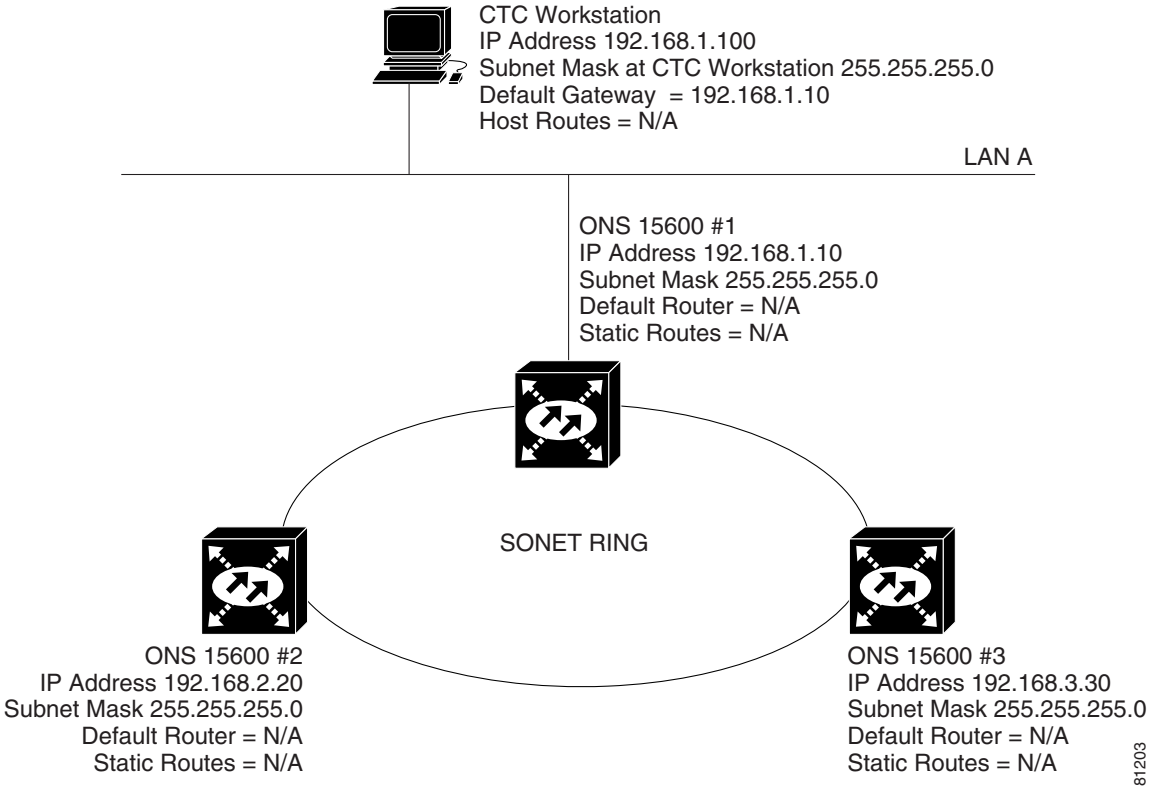
ARP matches higher-level IP addresses to the physical addresses of the destination host. It uses a lookup table (called the ARP cache) to perform the translation. When the address is not found in the ARP cache, a broadcast is sent out on the network with a special format called the ARP request. If one of the machines on the network recognizes its own IP address in the request, it sends an ARP reply back to the requesting host. The reply contains the physical hardware address of the receiving host. The requesting host stores this address in its ARP cache so that all subsequent datagrams (packets) to this destination IP address can be translated to a physical address.

Proxy ARP enables one LAN-connected ONS 15600 to respond to the ARP request for ONS 15600s that are not connected to the LAN. (ONS 15600 Proxy ARP requires no user configuration.) For this response to occur, the DCC-connected ONS 15600s must reside on the same subnet. When a LAN device sends an ARP request to an ONS 15600 that is not connected to the LAN, the gateway ONS 15600 returns its MAC address to the LAN device. The LAN device then sends the datagram for the remote ONS 15600 to the MAC address of the proxy ONS 15600. The proxy ONS 15600 uses its routing table to forward the datagram to the non-LAN ONS 15600.

9.2.4 Scenario 4: Default Gateway on CTC Computer

Scenario 4 is similar to Scenario 3, but Nodes 2 and 3 reside on different subnets, 192.168.2.0 and 192.168.3.0, respectively (Figure 9-4). Node 1 and the CTC computer are on subnet 192.168.1.0. For the CTC computer to communicate with Nodes 2 and 3, you would enter Node 1 as the default gateway on the CTC computer.

Figure 9-4 Scenario 4: Default Gateway on a CTC Computer



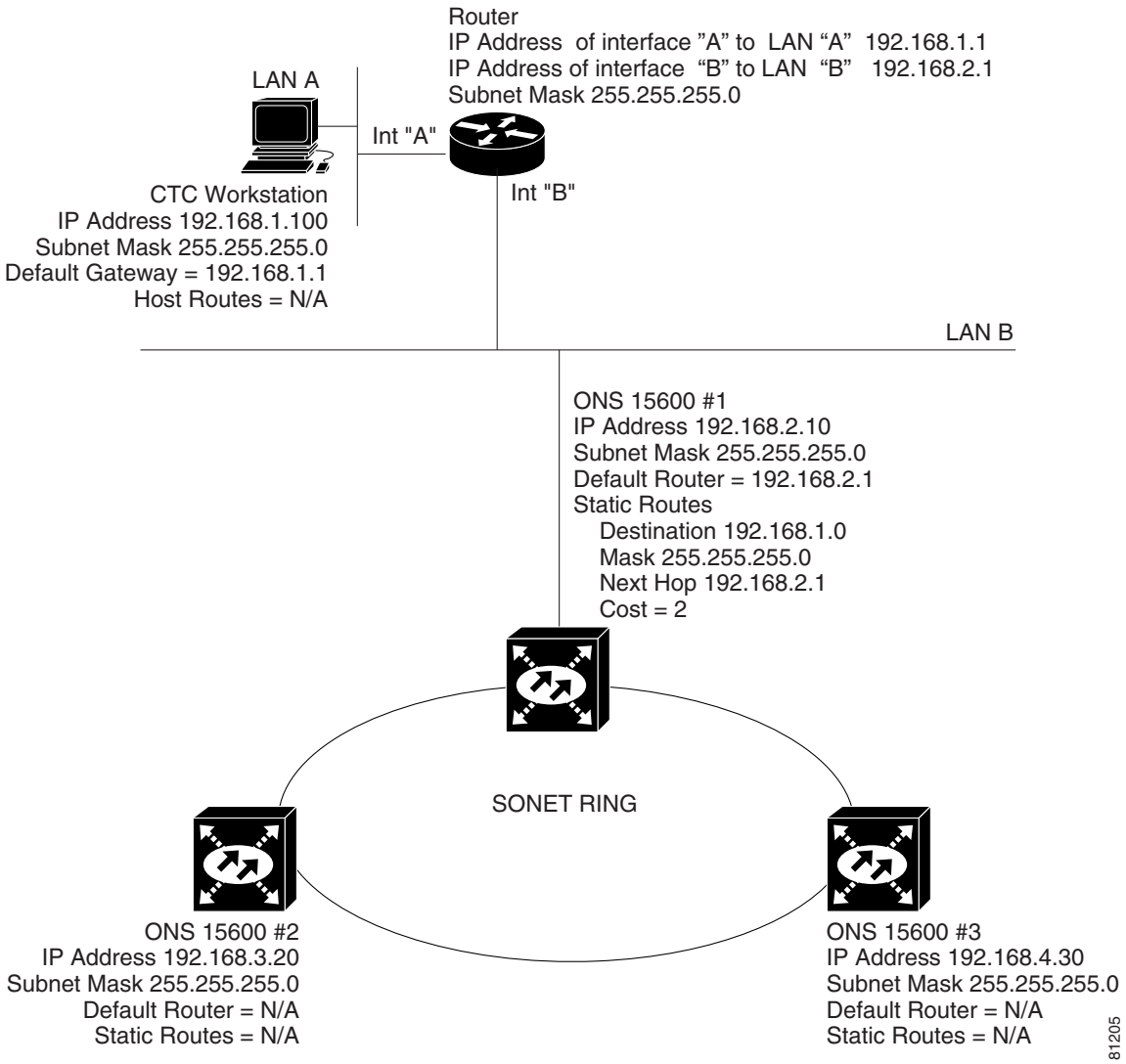
9.2.5 Scenario 5: Using Static Routes to Connect to LANs

Use static routes for the following two reasons:

- To connect ONS 15600s to CTC sessions on one subnet connected by a router to ONS 15600s residing on another subnet. (These static routes are not needed if OSPF is enabled. Scenario 6 shows an OSPF example.)
- To enable multiple CTC sessions among ONS 15600s residing on the same subnet.

In Figure 9-5, one CTC residing on subnet 192.168.1.0 connects to a router through interface A. (The router is not set up with OSPF.) ONS 15600s residing on subnet 192.168.2.0 are connected through Node 1 to the router through interface B. To connect to CTC computers on LAN A, you would create a static route on Node 1.

Figure 9-5 Scenario 5: Static Route with One CTC Computer Used as a Destination

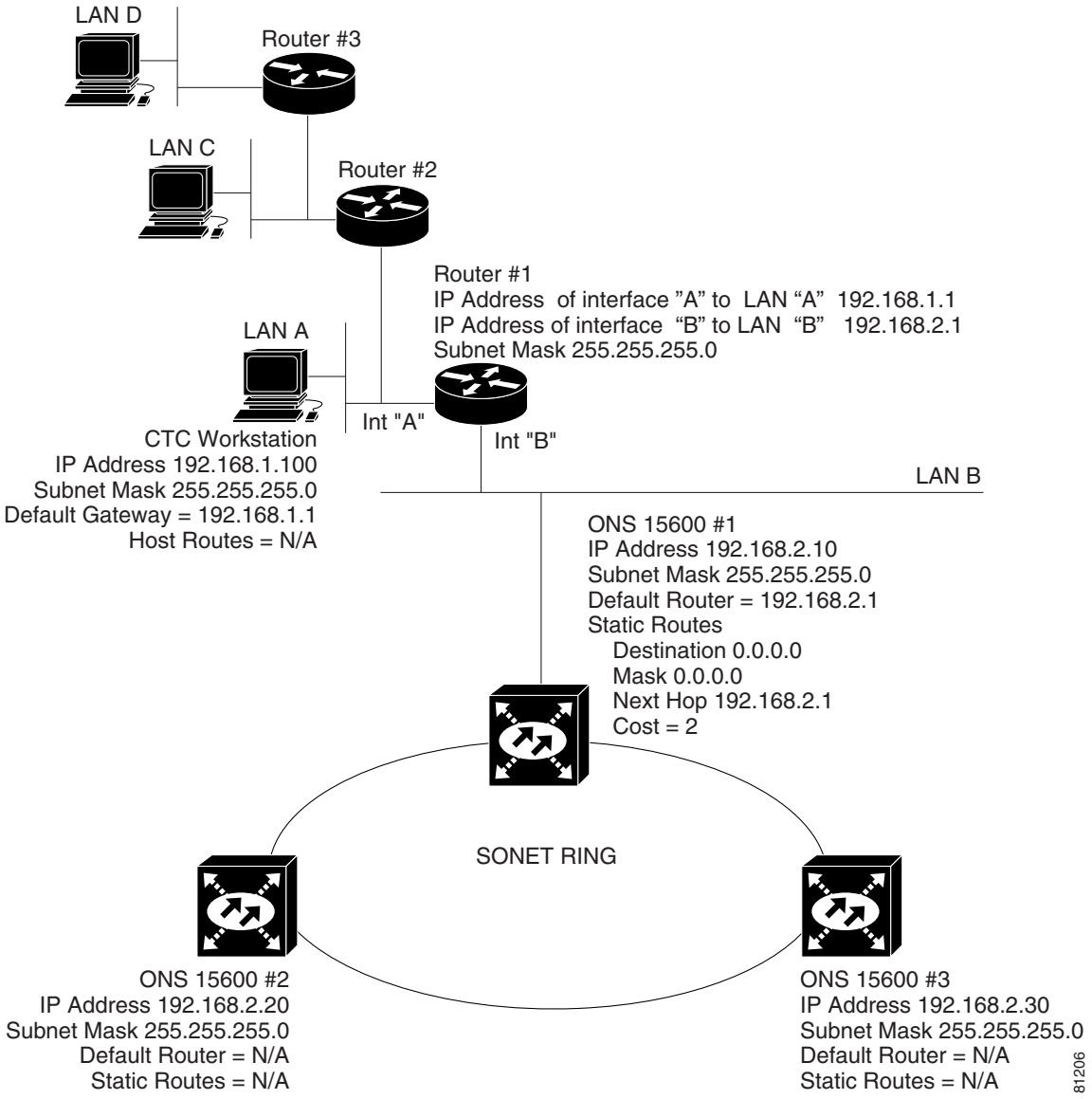


The destination and subnet mask entries control access to the ONS 15600s:

- If a single CTC computer will be connected to a router, enter the complete CTC "host route" IP address as the destination with a subnet mask of 255.255.255.255.
- If CTC computers on a subnet are connected to a router, enter the destination subnet (in this example, 192.168.1.0) and a subnet mask of 255.255.255.0.
- If all CTC computers are connected to router, enter a destination of 0.0.0.0 and a subnet mask of 0.0.0.0. Figure 9-6 shows an example.

In this figure, the IP address of router interface B is entered as the next hop (the next router that a packet traverses to reach its destination), and the cost (number of hops from source to destination) is 2.

Figure 9-6 Scenario 5: Static Route with Multiple LAN Destinations



9.2.6 Scenario 6: Using OSPF

OSPF is a link state Internet routing protocol. Link state protocols use a "hello protocol" to monitor their links with adjacent routers and to test their links with their neighbors. Link state protocols advertise their directly connected networks and their active links. Each link state router captures the link state advertisements (LSAs) and puts them together to create a topology of the entire network or area. From this database, the router calculates a routing table by constructing a shortest path tree. The router continuously recalculates to capture ongoing topology changes.

ONS 15600s use the OSPF protocol in internal ONS 15600 networks for node discovery, circuit routing, and node management. You can enable OSPF on the ONS 15600s so that the ONS 15600 topology is sent to OSPF routers on a LAN. Advertising the ONS 15600 network topology to LAN routers means

you do not need to manually enter static routes for ONS 15600 subnetworks. Figure 9-7 shows the same network enabled for OSPF. When you are logged into a ONS 15600 node, CTC does not allow both a DCC interface and a LAN interface in the same nonzero OSPF area.

Figure 9-7 Scenario 6: OSPF Enabled

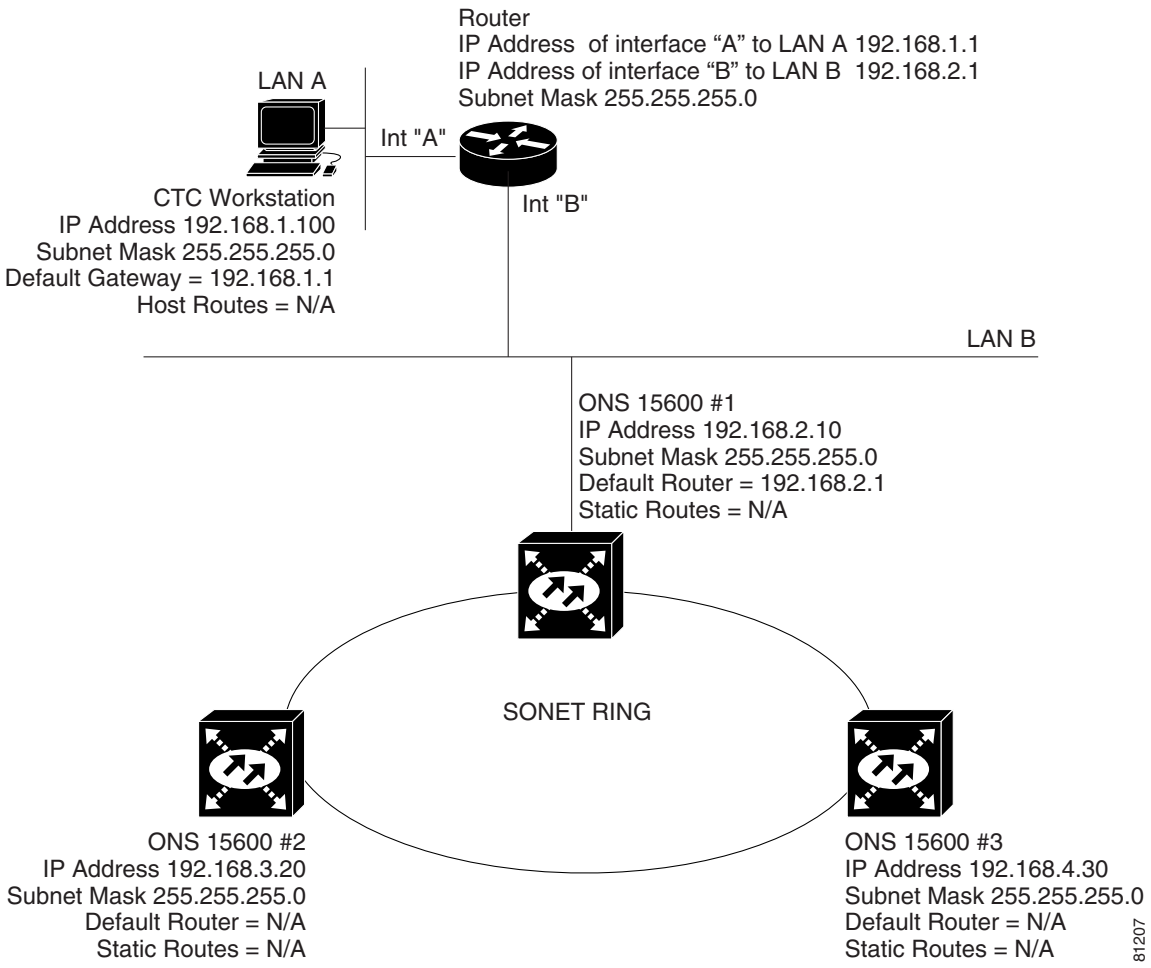
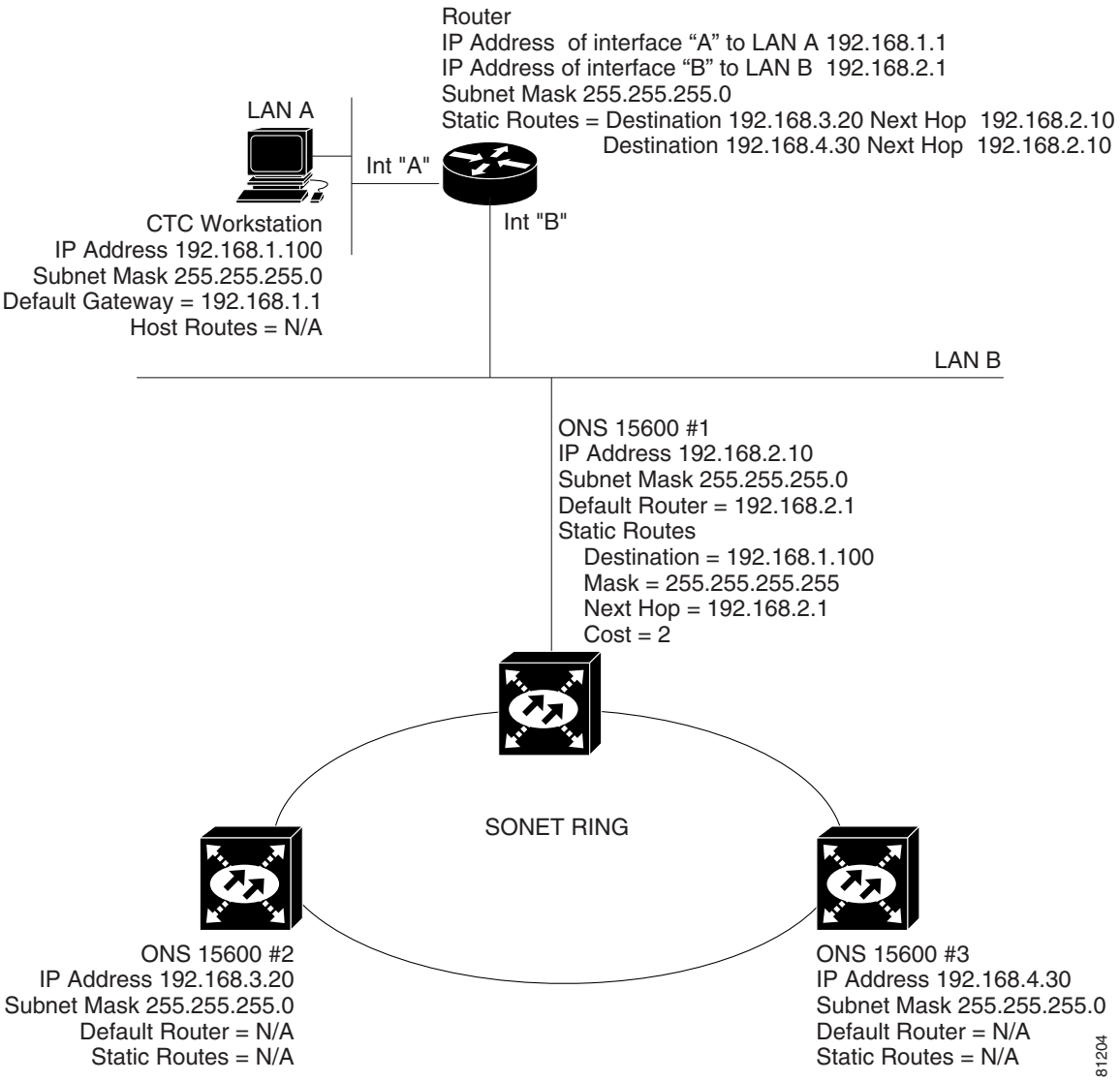


Figure 9-8 shows the same network without OSPF. Static routes must be manually added to the router in order for CTC computers on LAN A to communicate with Nodes 2 and 3 because these nodes reside on different subnets.

Figure 9-8 Scenario 6: OSPF Not Enabled



OSPF divides networks into smaller regions, called areas. An area is a collection of networked end systems, routers, and transmission facilities organized by traffic patterns. Each OSPF area has a unique ID number, known as the area ID, that can range from 0 to 4,294,967,295. Every OSPF network has one backbone area called "area 0." All other OSPF areas must connect to area 0.

When you enable ONS 15600 OSPF topology for advertising to an OSPF network, you must assign an OSPF area ID in decimal format to the ONS 15600 network. Coordinate the area ID number assignment with your LAN administrator. All DCC-connected ONS 15600s should be assigned the same OSPF area ID.

The ONS 15600 supports the multiple OSPF area feature, which allows the ability to configure and support multiple OSPF areas in each DCC-connected topology. A node is in a single OSPF area if all of its DCC or LAN interfaces are in the same OSPF area, while a node is in multiple OSPF areas if it has DCC or LAN interfaces in two or more OSPF areas. If the ONS 15600 has interfaces (DCC or LAN) in multiple OSPF areas, at least one ONS 15600 interface (DCC or LAN) must be in the backbone area 0.

If multiple ONS 15600 nodes and routers are connected to the same LAN in OSPF backbone area 0 and a link between two routers breaks, the backbone OSPF area 0 could divide into multiple gateway network elements (GNEs). If this occurs, the CTC session connected to Router 1 will not be able to communicate with the ONS 15600 connected to Router 2. To resolve, you must repair the link between the routers or provide another form of redundancy in the network. This is standard behavior for an OSPF network.

Note To create OSPF virtual links, OSPF must be enabled on the LAN.

Note Cisco recommends limiting the number of link-state packets (LSPs) that will be forwarded over the DCC interfaces.

9.2.7 Scenario 7: Provisioning the ONS 15600 Proxy Server

The ONS 15600 proxy server is a set of functions that allows you to configure ONS 15600s in environments where visibility and accessibility between ONS 15600s and CTC computers must be restricted. For example, you can set up a network so that field technicians and network operations center (NOC) personnel can both access the same ONS 15600s while preventing the field technicians from accessing the NOC LAN. To do this, one ONS 15600 is provisioned as a GNE and the other ONS 15600s are provisioned as ENEs. The GNE ONS 15600 tunnels connections between CTC computers and ENE ONS 15600s, providing management capability while preventing access for purposes other than ONS 15600 management.

The ONS 15600 proxy server performs the following tasks:

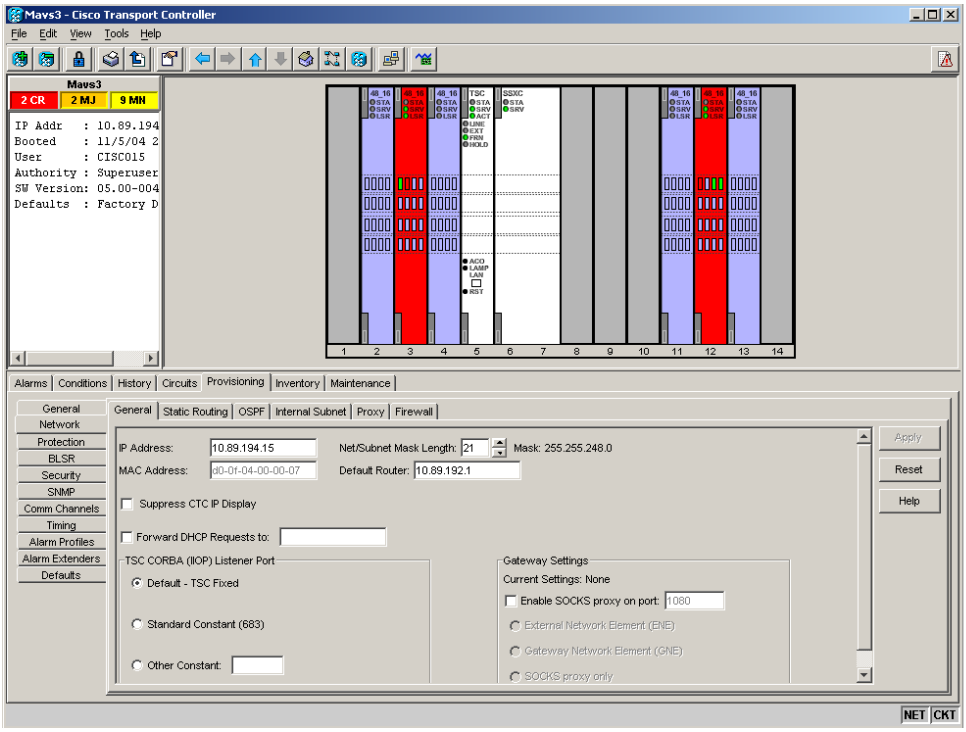
- Isolates DCC IP traffic from Ethernet (craft port) traffic and accepts packets based on filtering rules. The filtering rules (see Table 9-3 on page 9-16 and Table 9-4 on page 9-16) depend on whether the packet arrives at the ONS 15600 DCC or TSC Ethernet interface.
- Processes Simple Network Time Protocol/Network Time Protocol (SNTP/NTP) requests. ONS 15600 ENEs can derive time-of-day from an SNTP/NTP LAN server through the ONS node GNE.
- Process SNMPv1 traps. The GNE ONS 15600 receives SNMPv1 traps from the ONS node ENEs and forwards them to all provisioned SNMPv1 trap destinations.

The ONS 15600 proxy server is provisioned using the Enable SOCKS proxy on port check box on the Provisioning > Network > General tab (see Figure 9-9). If checked, the ONS 15600 serves as a proxy for connections between CTC clients and ONS 15600s that are DCC-connected to the proxy ONS 15600. The CTC client establishes connections to DCC-connected nodes through the proxy node. The CTC client can connect to nodes that it cannot directly reach from the host on which it runs. If not selected, the node does not proxy for any CTC clients, although any established proxy connections continue until the CTC client exits. If set as a GNE, the CTC computer is visible to other DCC-connected nodes and firewall is enabled. If Proxy-only is selected, the firewall is not enabled. CTC can communicate with any other DCC-connected ONS 15600s.

Note The ONS 15600 ENE option on the Provisioning > Network > General tab behaves the same as the GNE option.

Note If you launch CTC against a node through a NAT (Network Address Translation) or PAT (Port Address Translation) router and that node does not have proxy enabled, your CTC session starts and initially appears to be fine. However CTC never receives alarm updates and disconnects and reconnects every two minutes. If the proxy is accidentally disabled, it is still possible to enable the proxy during a reconnect cycle and recover your ability to manage the node, even through a NAT/PAT firewall.

Figure 9-9 Proxy Server Gateway Settings



9.2.7.1 Firewall Not Enabled

Figure 9-10 shows an ONS 15600 proxy server implementation. A ONS 15600 GNE is connected to a central office LAN and to ONS 15600 ENEs. The central office LAN is connected to a NOC LAN, which has CTC computers. The NOC CTC computer and craft technicians must both be able to access the ONS 15600 ENEs. However, the craft technicians must be prevented from accessing or seeing the NOC or central office LANs.

In the example, the ONS 15600 GNE is assigned an IP address within the central office LAN and is physically connected to the LAN through its LAN port. ONS 15600 ENEs are assigned IP addresses that are outside the central office LAN and given private network IP addresses. If the ONS 15600 ENEs are collocated, the craft LAN ports could be connected to a hub. However, the hub should have no other network connections.

Figure 9-10 ONS 15600 Proxy Server with GNE and ENEs on the Same Subnet

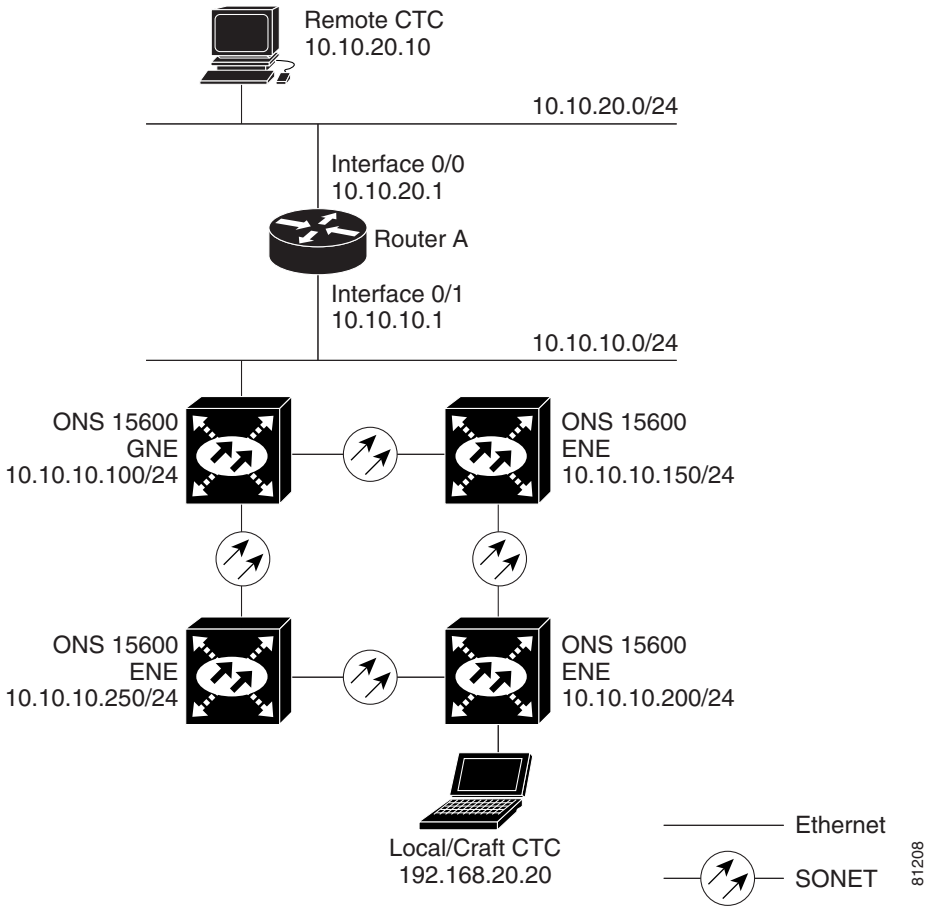


Table 9-2 shows recommended settings for ONS 15600 GNEs and ENEs in the configuration shown in Figure 9-10.

Table 9-2 ONS 15600 GNE and ENE Settings

Setting	ONS 15600 GNE	ONS 15600 ENE
Enable proxy server on port	On	On
GNE	On	Off
ENE	Off	On
Proxy only	Off	Off
OSPF (LAN)	Off	Off
SNTP server (if used)	SNTP server IP address	Set to the ONS 15600 GNE IP address
SNMP (if used)	SNMPv1 trap destinations	Set SNMPv1 trap destinations to ONS 15600 GNE, port 391

Figure 9-11 shows the same proxy server implementation with ONS 15600 ENEs on different subnets. The ONS 15600 GNEs and ENEs are provisioned with the settings shown in Table 9-2.

Figure 9-11 Scenario 7: ONS 15600 Proxy Server with GNE and ENEs on Different Subnets

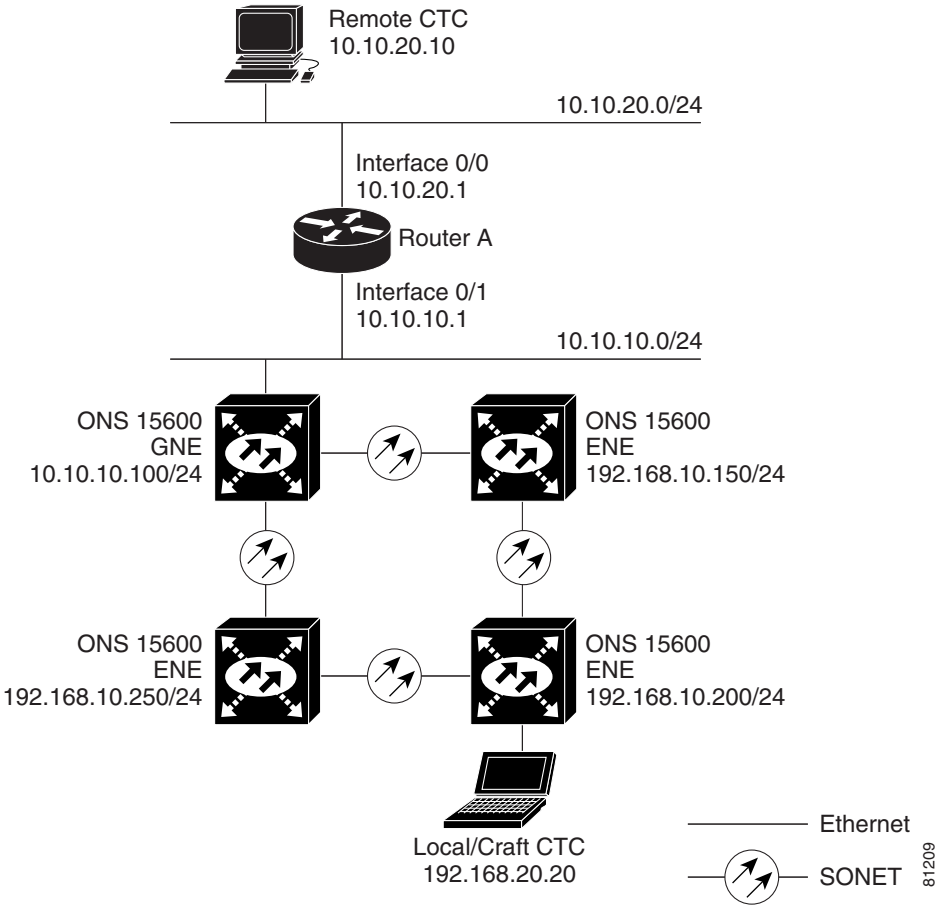
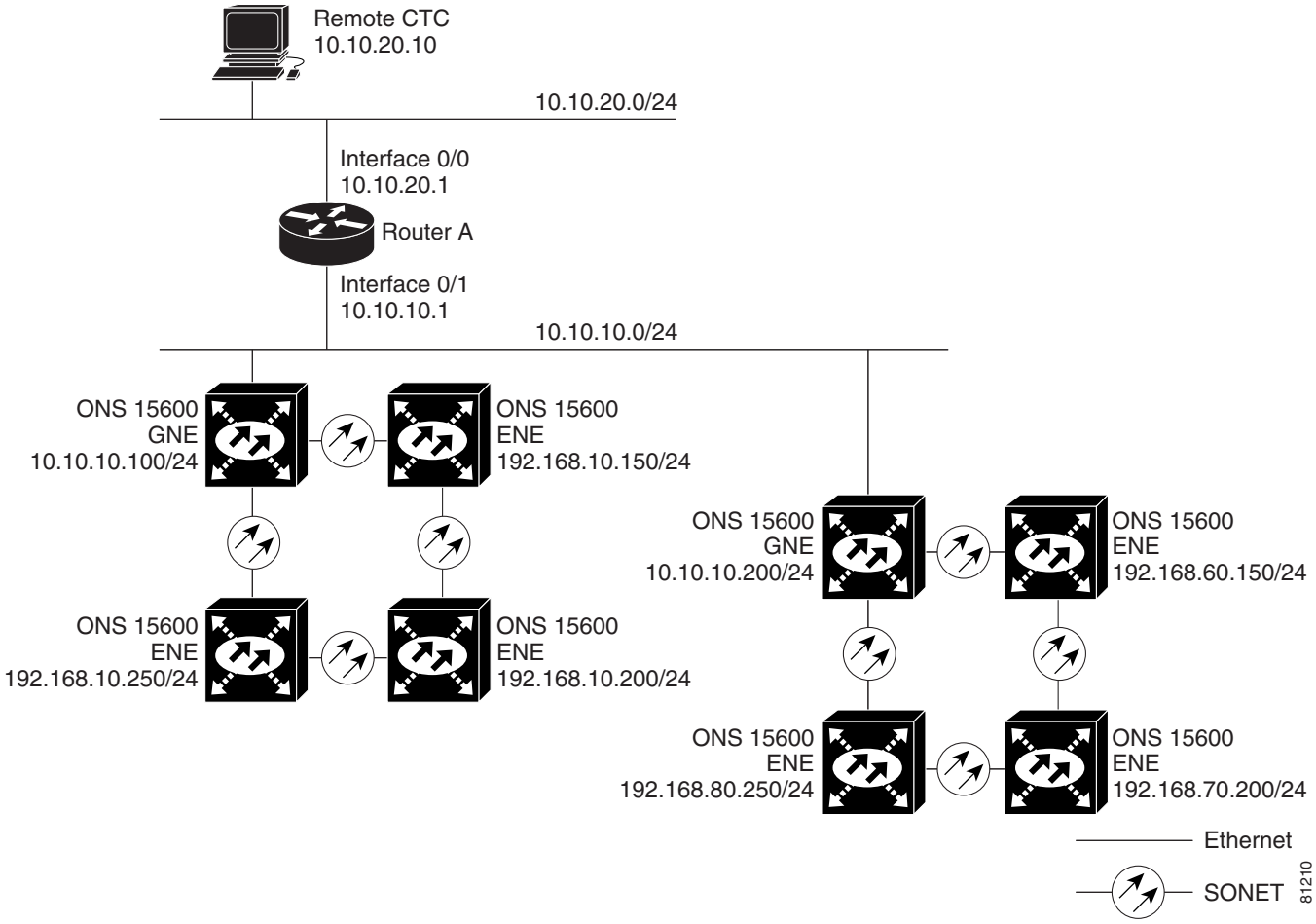


Figure 9-12 shows the Figure 9-11 implementation with ONS 15600 ENEs in multiple rings. The ONS 15600 GNEs and ENEs are provisioned with the settings shown in Table 9-2.

Figure 9-12 Scenario 7: ONS 15600 Proxy Server With ENEs on Multiple Rings



9.2.7.2 Firewall Enabled

Table 9-3 shows the rules the ONS 15600 uses to filter packets when the firewall is enabled.

Table 9-3 Proxy Server Firewall Filtering Rules

Packets Arriving At:	Are Accepted if the IP Destination Address Is:
TSC Ethernet interface	• The ONS 15600 itself • The ONS 15600 subnet broadcast address • Within the 224.0.0.0/8 network (reserved network used for standard multicast messages)
DCC interface	• The ONS 15600 itself • Any destination connected through another DCC interface • Within the 224.0.0.0/8 network

The rules in Table 9-4 are applied if a packet is addressed to the ONS 15600. Rejected packets are discarded.

Table 9-4 Proxy Server Firewall Filtering Rules When Packet Addressed to ONS 15600

Packets Arriving At:	Accepts	Rejects
TSC Ethernet interface	• All IP protocols except user datagram protocol (UDP) • All UDP packets except packets address to the SNMP trap relay port	• UDP packets addressed to the SNMP trap relay port (391)
DCC interface	• All ICMP, OSPF, RSVP, and LMP packets • All TCP packets except packets addressed to the Telnet and proxy server ports	• TCP packets addressed to the Telnet port • TCP packets addressed to the proxy server port • Protocols not listed in the Accepted column

If an ONS 15600 or CTC computer resides behind a firewall that uses port filtering, you must enable an Internet Inter-ORB Protocol (IIOP) port on the ONS 15600 and/or CTC computer, depending on whether one or both devices reside behind a firewall. You can enable an IIOP port on the Provisioning > Network > General tabs in CTC.

Figure 9-13 shows ONS 15600s in a protected network and the CTC computer in an external network. For the computer to access the ONS 15600s, you must provision the IIOP listener port specified by your firewall administrator on the ONS 15600. The ONS 15600 sends the port number to the CTC computer during the initial contact between the devices using Hyper-Text Transfer Protocol (HTTP). After the CTC computer obtains the ONS 15600 IIOP port, the computer opens a direct session with the node using the specified IIOP port.

Figure 9-13 Nodes Behind a Firewall

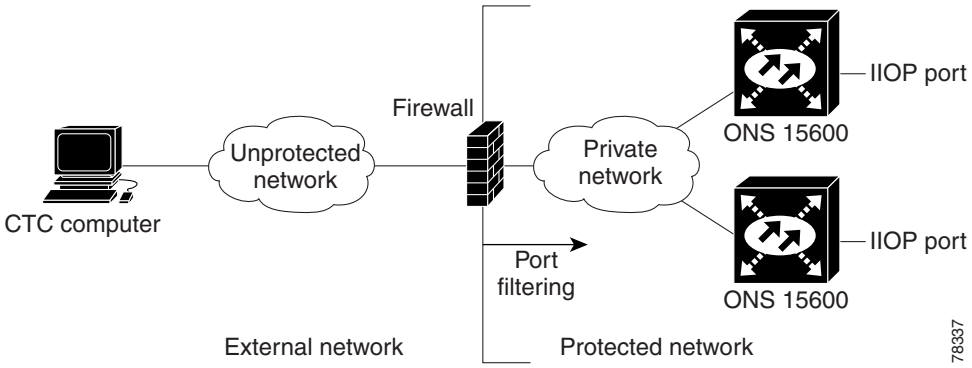
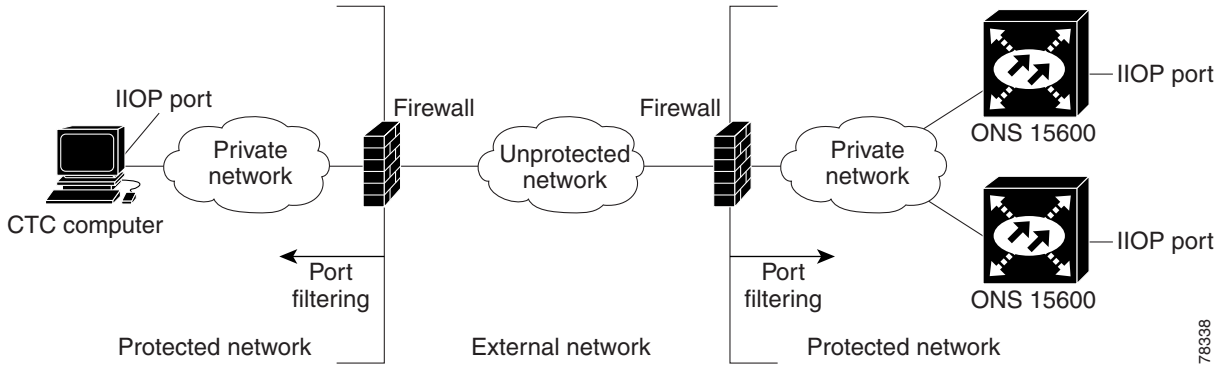


Figure 9-14 shows a CTC computer and ONS 15600s behind firewalls. For the computer to access the ONS 15600, you must provision the IIOP port on the CTC computer and on the ONS 15600. Each firewall can use a different IIOP port. For example, if the CTC computer firewall uses IIOP port 4000, and the ONS 15600 firewall uses IIOP port 5000, 4000 is the IIOP port you provision for the CTC computer and 5000 is the IIOP port you provision for the ONS 15600.

Figure 9-14 CTC Computer and ONS 15600s Residing Behind Firewalls



If you implement the proxy server, note that all DCC-connected ONS 15600s on the same Ethernet segment must have the same gateway setting. Mixed values produce unpredictable results, and might leave some nodes unreachable through the shared Ethernet segment.

If nodes become unreachable, correct the setting by performing one of the following actions:

- Disconnect the craft computer from the unreachable ONS 15600. Connect to the ONS 15600 through another network ONS 15600 that has a DCC connection to the unreachable ONS 15600.
- Disconnect all DCCs to the node by disabling them on neighboring nodes. Connect a CTC computer directly to the ONS 15600 and change its provisioning.

9.2.8 Scenario 8: Dual GNEs on a Subnet

The ONS 15600 provides GNE load balancing, which allows CTC to reach ENEs over multiple GNEs without the ENEs being advertised over OSPF. This feature allows a network to quickly recover from the loss of a GNE, even if the GNE is on a different subnet. If a GNE fails, all connections through that GNE fail. CTC disconnects from the failed GNE and from all ENEs for which the GNE was a proxy and

then reconnects through the remaining GNEs. GNE load balancing reduces the dependency on the launch GNE and DCC bandwidth, which enhances CTC performance. Figure 9-15 shows a network with dual GNEs on the same subnet.

Figure 9-15 Scenario 8: Dual GNEs on the Same Subnet

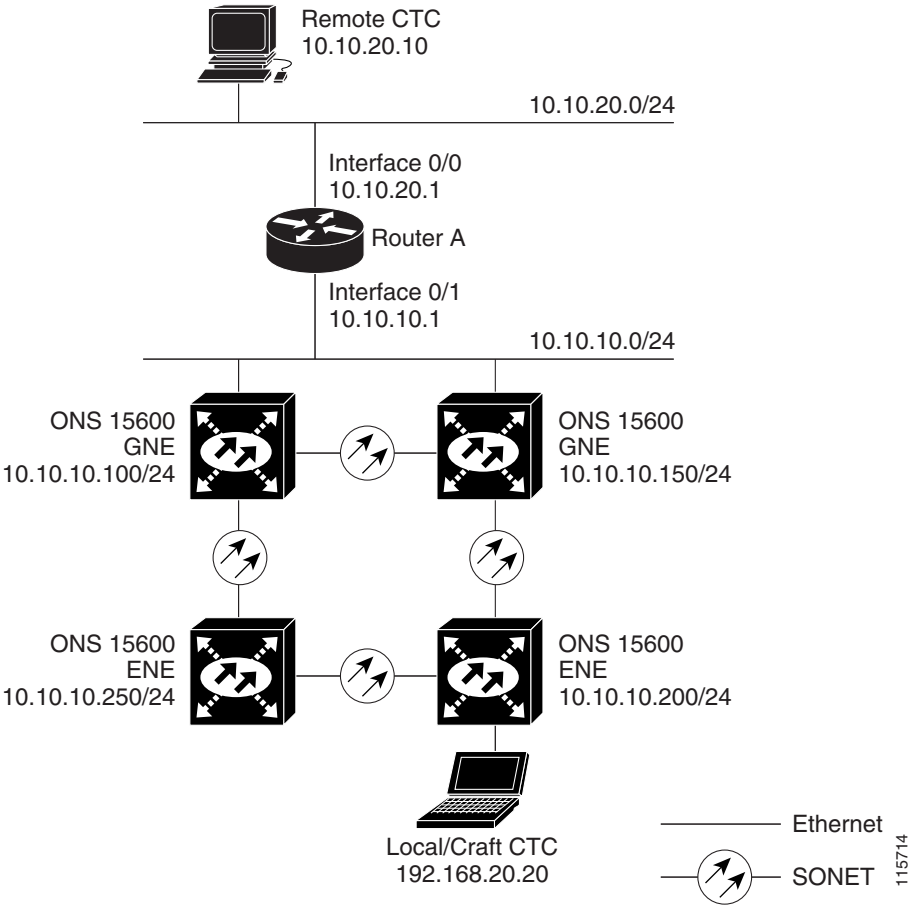
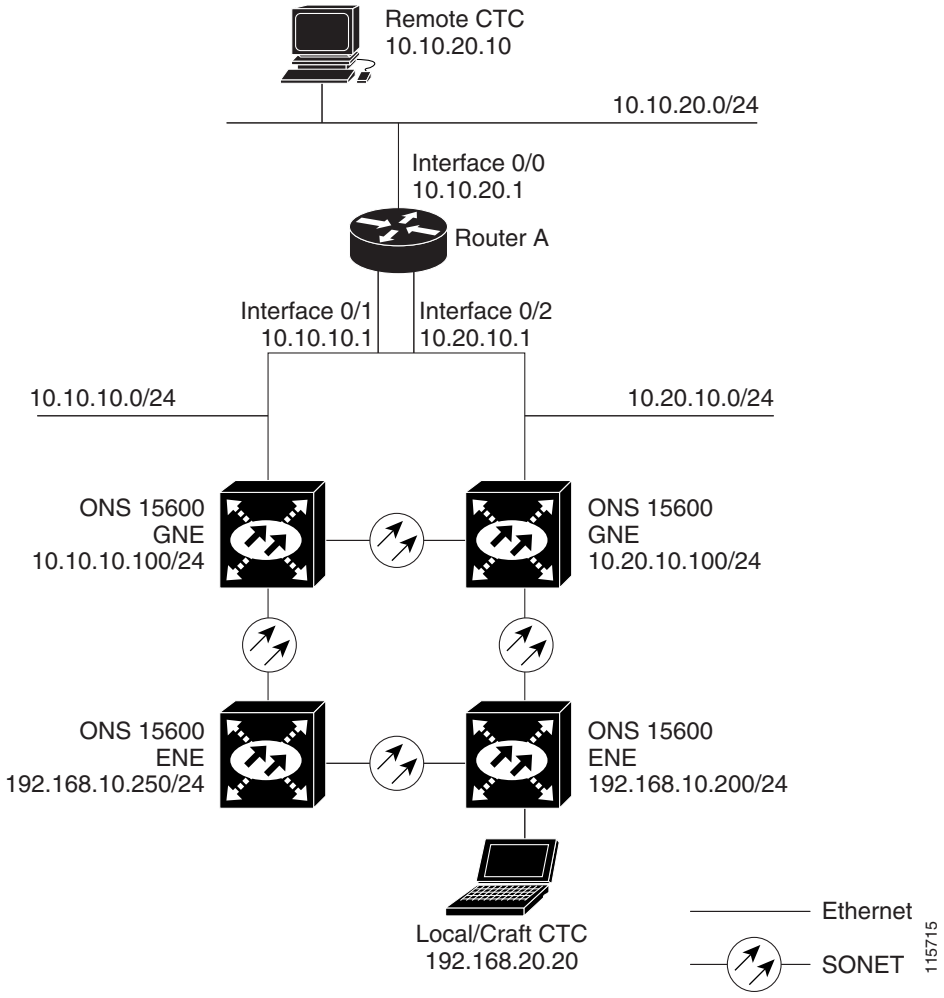


Figure 9-16 shows a network with dual GNEs on different subnets.

Figure 9-16 Scenario 8: Dual GNEs on Different Subnets



9.3 Provisionable Patchcords

A provisionable patchcord is a user-provisioned link that is advertised by OSPF throughout the network. Provisionable patchcords, also called virtual links, are needed if an ONS 15600 optical port is connected to an ONS 15454 transponder or muxponder client port provisioned in transparent mode. Provisionable patchcords are required on both ends of a physical link. The provisioning at each end includes a local patchcord ID, slot and port information, remote IP address, and remote patchcord ID. Patchcords appear as dashed lines in CTC network view.

Table 9-5 lists the supported combinations for ONS 15600 optical cards and the ONS 15454 transponder/muxponder cards used in a provisionable patchcord. For more information about the ONS 15454 transponder and muxponder cards, refer to the *Cisco ONS 15454 DWDM Reference Manual*.

Table 9-5 ONS 15600 and ONS 15454 Client and Trunk Card Combinations in Provisionable Patchcords

	ONS 15454 Client Cards		
ONS 15600 Trunk Cards	**MXP_2.5G_10G/ TXP_MR_10G**	**TXP(P)_MR_2.5G**	**MXP_2.5G_10E/ TXP_MR_10E**
OC-192	Yes	—	Yes
OC-48	Yes	Yes	Yes
ASAP (OC-48 PPM)	Yes	Yes	Yes

Optical ports have the following requirements when used in a provisionable patchcord:

- An optical port connected to an ONS 15454 transponder or muxponder port requires an SDCC or LDCC termination.
- If the optical port is the protection port in a 1+1 group, the working port must have an SDCC or LDCC termination provisioned.
- If a remote end (ONS 15454) of a provisionable patchcord is Y-cable protected, an optical port requires two patchcords.

9.4 Routing Table

ONS 15600 routing information appears on the Maintenance > Routing Table tabs (Figure 9-17). The routing table provides the following information:

- Destination—Displays the IP address of the destination network or host.
- Mask—Displays the subnet mask used to reach the destination host or network.
- Gateway—Displays the IP address of the gateway used to reach the destination network or host.
- Usage—Shows the number of times this route has been used.
- Interface—Shows the ONS 15600 interface used to access the destination.
  - pend0—The Ethernet management interface.
  - pdcc—An SDCC interface, that is, an OC-N trunk (span) card identified as the SDCC termination (0 to 128).
  - lo0—A loopback interface.
  - pend2—The craft-only RJ-45 jack on the front of the TSC.
  - motfcc0—Interface on the TSC that connect the TSC to all other cards except the other TSC.
  - hdlc0—Connects the two TSC cards together; traffic cards forward DCC packets over the motfcc0 Ethernet interface.

Figure 9-17 Viewing the ONS 15600 Routing Table

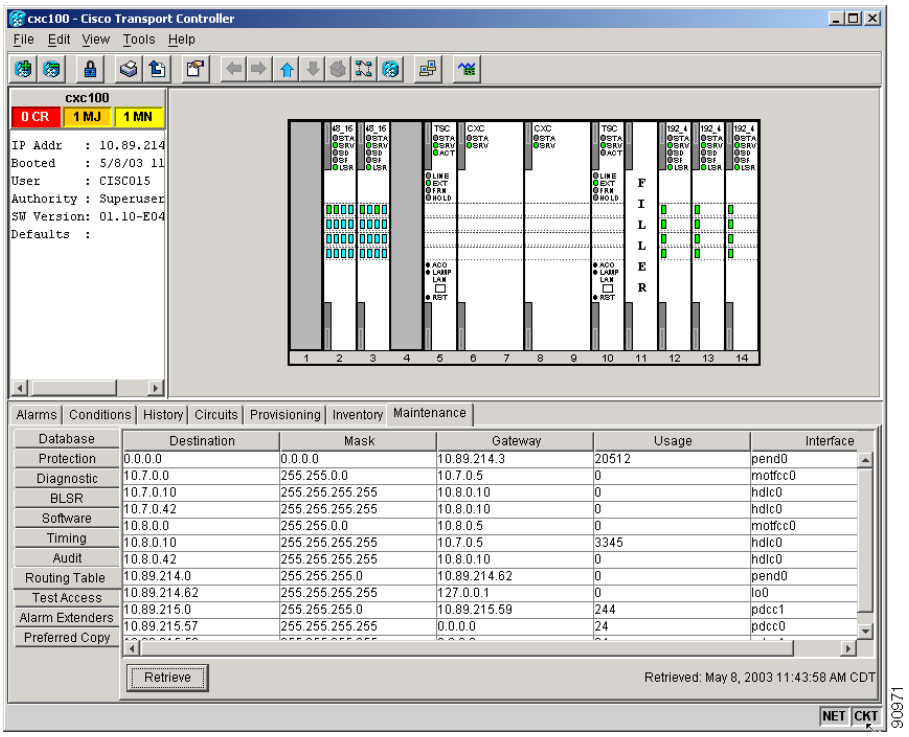


Table 9-6 shows sample routing entries for an ONS 15600.

Table 9-6 Sample Routing Table Entries

Entry	Destination	Mask	Gateway	Interface
1	0.0.0.0	0.0.0.0	172.20.214.1	cpm0
2	172.20.214.0	255.255.255.0	172.20.214.92	cpm0
3	172.20.214.92	255.255.255.255	127.0.0.1	lo0
4	172.20.214.93	255.255.255.255	0.0.0.0	pdcc0
5	172.20.214.94	255.255.255.255	172.20.214.93	pdcc0

Entry 1 shows the following:

- Destination (0.0.0.0) is the default route entry. All undefined destination network or host entries on this routing table will be mapped to the default route entry.
- Mask (0.0.0.0) is always 0 for the default route.
- Gateway (172.20.214.1) is the default gateway address. All outbound traffic that cannot be found in this routing table or is not on the node's local subnet will be sent to this gateway.
- Interface (cpm0) indicates that the ONS 15600 Ethernet interface is used to reach the gateway.

Entry 2 shows the following:

- Destination (172.20.214.0) is the destination network IP address.
- Mask (255.255.255.0) is a 24-bit mask, meaning all addresses within the 172.20.214.0 subnet can be destinations.

- Gateway (172.20.214.92) is the gateway address. All outbound traffic belonging to this network is sent to this gateway.
- Interface (cpm0) indicates that the ONS 15600 Ethernet interface is used to reach the gateway.

Entry 3 shows the following:

- Destination (172.20.214.92) is the destination host IP address.
- Mask (255.255.255.255) is a 32-bit mask, meaning only the 172.20.214.92 address is a destination.
- Gateway (127.0.0.1) is a loopback address. The host directs network traffic to itself using this address.
- Interface (lo0) indicates that the local loopback interface is used to reach the gateway.

Entry 4 shows the following:

- Destination (172.20.214.93) is the destination host IP address.
- Mask (255.255.255.255) is a 32-bit mask, meaning only the 172.20.214.93 address is a destination.
- Gateway (0.0.0.0) means the destination host is directly attached to the node.
- Interface (pdcc0) indicates that a SONET DCC interface is used to reach the destination host.

Entry 5 shows a DCC-connected node that is accessible through a node that is not directly connected:

- Destination (172.20.214.94) is the destination host IP address.
- Mask (255.255.255.255) is a 32-bit mask, meaning only the 172.20.214.94 address is a destination.
- Gateway (172.20.214.93) indicates that the destination host is accessed through a node with the IP address 172.20.214.93.
- Interface (pdcc0) indicates that a SONET DCC interface is used to reach the gateway.

9.5 External Firewalls

This section provides sample access control lists for external firewalls. Table 9-7 lists the ports that are used by the TSC.

Table 9-7 Ports Used by the TSC

Port	Function	Action[1]
0	Never used	D
20	FTP	D
21	FTP control	D
22	SSH (Secure Shell)	D
23	Telnet	D
80	HTTP	D
111	SUNRPC (Sun Remote Procedure Call)	D
161	SNMP traps destinations	D
162	SNMP traps destinations	D
513	rlogin	D
683	CORBA IIOP	OK

Table 9-7 Ports Used by the TSC (continued)

Port	Function	Action[1]
1080	Proxy server (socks)	D
2001-2017	I/O card Telnet	NA
2018	DCC processor on active TCC2/TCC2P	D
2361	TL1	D
3082	Raw TL1	D
3083	TL1	D
5001	BLSR server port	D
5002	BLSR client port	D
7200	SNMP alarm input port	D
9100	EQM port	D
9401	TCC boot port	D
9999	Flash manager	NA
10240-12287	Proxy client	D
57790	Default TCC listener port	OK

1. D = deny, NA = not applicable, OK = do not deny

The following ACL (access control list) example shows a firewall configuration when the SOCKS proxy server gateway setting is not enabled. In the example, the CTC workstation's address is 192.168.10.10. and the ONS 15600 address is 10.10.10.100. The firewall is attached to the GNE, so the inbound direction is from CTC to the GNE and the outbound direction is from the GNE to CTC. The CTC Common Object Request Broker Architecture (CORBA) Standard constant is 683 and the TCC CORBA Default is TCC Fixed (57790).

```
access-list 100 remark *** Inbound ACL, CTC -> NE ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 eq www
access-list 100 remark *** allows initial contact with ONS 15600 using http (port 80) ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 eq 57790
access-list 100 remark *** allows CTC communication with ONS 15600 GNE (port 57790) ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 established
access-list 100 remark *** allows ACKs back from CTC to ONS 15600 GNE ***

access-list 101 remark *** Outbound ACL, NE -> CTC ***
access-list 101 remark
access-list 101 permit tcp host 10.10.10.100 host 192.168.10.10 eq 683
access-list 101 remark *** allows alarms etc., from the 15600 (random port) to the CTC
workstation (port 683) ***
access-list 100 remark
access-list 101 permit tcp host 10.10.10.100 host 192.168.10.10 established
access-list 101 remark *** allows ACKs from the 15600 GNE to CTC ***
```

The following ACL (access control list) example shows a firewall configuration when the SOCKS proxy server gateway setting is enabled. As with the first example, the CTC workstation address is 192.168.10.10 and the ONS 15600 address is 10.10.10.100. The firewall is attached to the GNE, so inbound is CTC to the GNE and outbound is from the GNE to CTC. CTC CORBA Standard constant (683) and TCC CORBA Default is TCC Fixed (57790).

```
access-list 100 remark *** Inbound ACL, CTC -> NE ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 eq www
access-list 100 remark *** allows initial contact with the 15600 using http (port 80) ***
access-list 100 remark
access-list 100 permit tcp host 192.168.10.10 host 10.10.10.100 eq 1080
access-list 100 remark *** allows CTC communication with the 15600 GNE (port 1080) ***
access-list 100 remark

access-list 101 remark *** Outbound ACL, NE -> CTC ***
access-list 101 remark
access-list 101 permit tcp host 10.10.10.100 host 192.168.10.10 established
access-list 101 remark *** allows ACKs from the 15600 GNE to CTC ***
```

9.6 Open GNE

The ONS 15600 can communicate with non-ONS nodes that do not support point-to-point protocol (PPP) vendor extensions or OSPF type 10 opaque link-state advertisements (LSA), both of which are necessary for automatic node and link discovery. An open GNE configuration allows the DCC-based network to function as an IP network for non-ONS nodes.

To configure an open GNE network, you can provision SDCC and LDCC terminations to include a far-end, non-ONS node using either the default IP address of 0.0.0.0 or a specified IP address. You provision a far-end, non-ONS node by checking the “Far End is Foreign” check box during SDCC and LDCC creation. The default 0.0.0.0 IP address allows the far-end, non-ONS node to provide the IP address; if you set an IP address other than 0.0.0.0, a link is established only if the far-end node identifies itself with that IP address, providing an extra level of security.

By default, the proxy server only allows connections to discovered ONS peers and the firewall blocks all IP traffic between the DCC network and LAN. You can, however, provision proxy tunnels to allow up to 12 additional destinations for SOCKS version 5 connections to non-ONS nodes. You can also provision firewall tunnels to allow up to 12 additional destinations for direct IP connectivity between the DCC network and LAN. Proxy and firewall tunnels include both a source and destination subnet. The connection must originate within the source subnet and terminate within the destination subnet before either the SOCKS connection or IP packet flow is allowed.

To set up proxy and firewall subnets in CTC, use the Provisioning > Network > Proxy and Firewalls subtabs. The availability of proxy and/or firewall tunnels depends on the network access settings of the node:

- If the node is configured with the proxy server enabled in GNE or ENE mode, you must set up a proxy tunnel and/or a firewall tunnel.
- If the node is configured with the proxy server enabled in proxy-only mode, you can set up proxy tunnels. Firewall tunnels are not allowed.
- If the node is configured with the proxy server disabled, neither proxy tunnels or firewall tunnels are allowed.

Figure 9-18 shows an example of a foreign node connected to the DCC network. Proxy and firewall tunnels are useful in this example because the GNE would otherwise block IP access between the PC and the foreign node.

Figure 9-18 Proxy and Firewall Tunnels for Foreign Terminations

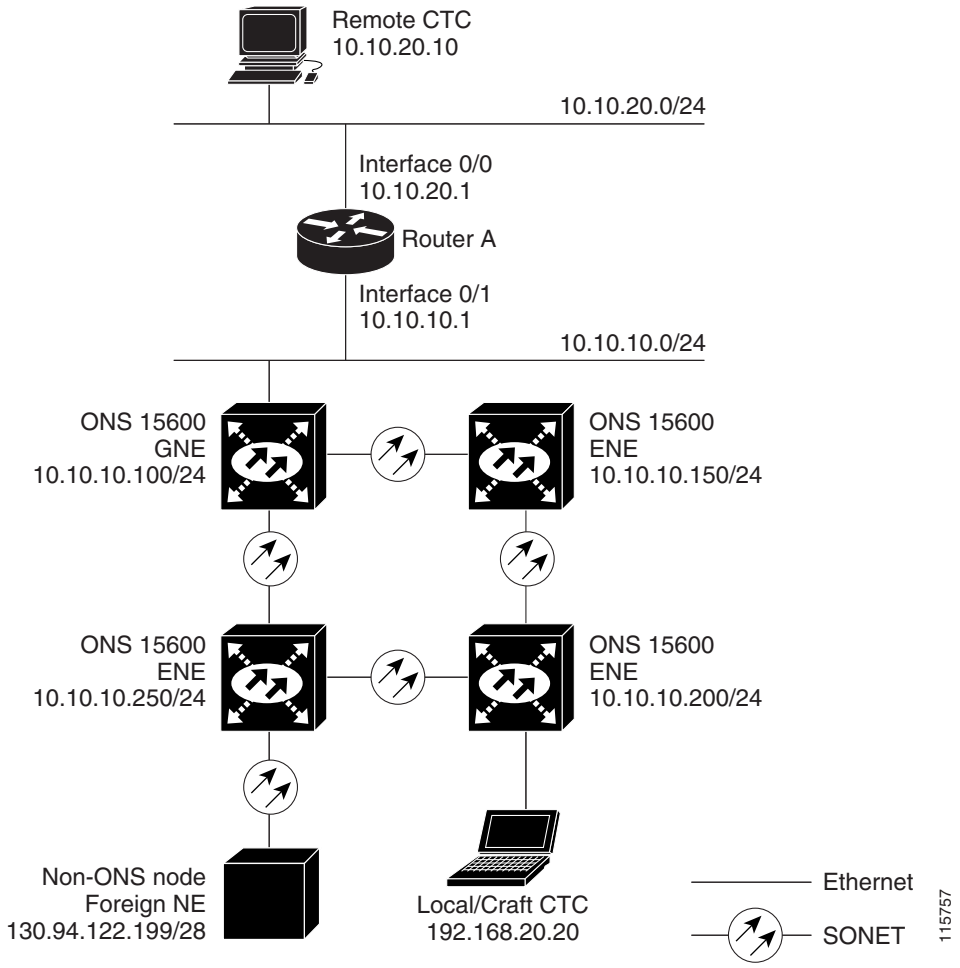
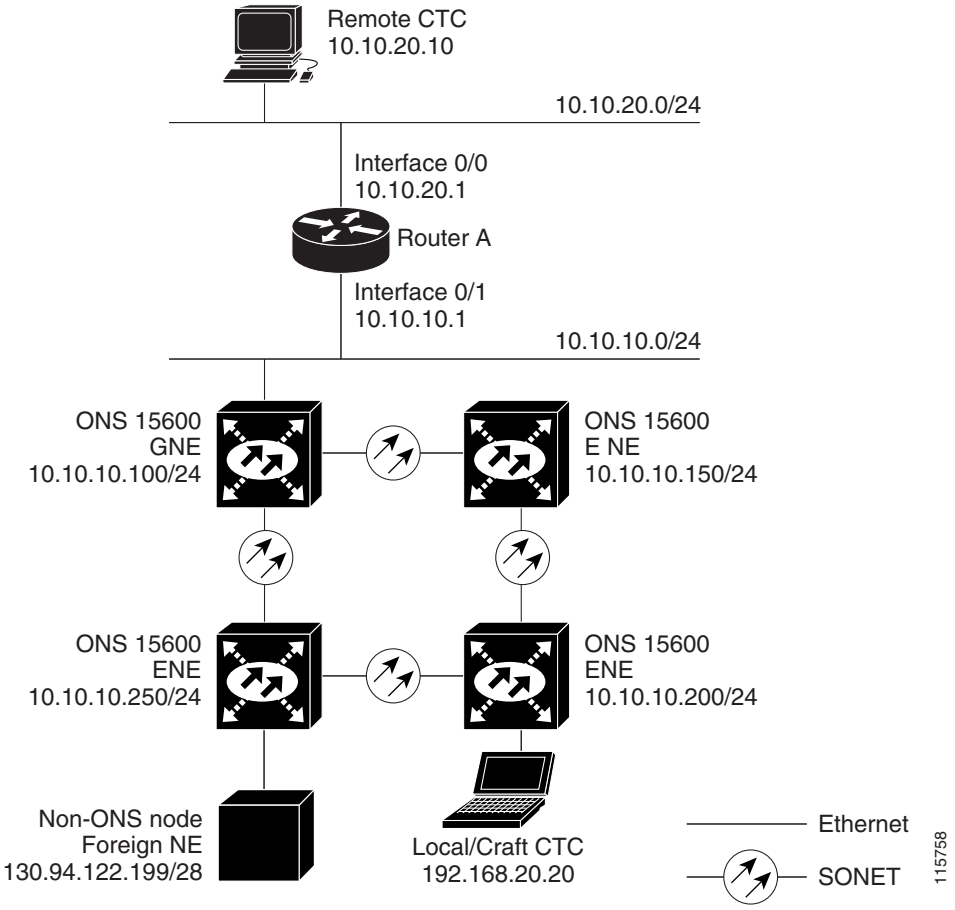


Figure 9-19 shows a remote node connected to an ENE Ethernet port. Proxy and firewall tunnels are useful in this example because the GNE would otherwise block IP access between the PC and foreign node. This configuration also requires a firewall tunnel on the ENE.

Figure 9-19 Foreign Node Connection to an ENE Ethernet Port



9.7 TCP/IP and OSI Networking

ONS 15600 DCN communication is based on the TCP/IP protocol suite. However, ONS 15600s can also be networked with equipment that uses the OSI protocol suite. While TCP/IP and OSI protocols are not directly compatible, they do have the same objectives and occupy similar layers of the OSI reference model. Table 9-8 shows the protocols and mediation processes that are involved when TCP/IP-based NEs are networked with OSI-based NEs.

Table 9-8 TCP/IP and OSI Protocols

OSI Model	IP Protocols	OSI Protocols		IP-OSI Mediation
Layer 7 Application	• TL1 • FTP • HTTP • Telnet • IIOP	• TARP[1]	• TL1 (over OSI) • FTAM[2] • ACSE[3]	• T–TD[4] • FT–TD[5]
Layer 6 Presentation			• PST[6]	—
Layer 5 Session			• Session	—
Layer 4 Transport	• TCP • UDP		• TP (Transport) Class 4	• IP-over-CLNS[7] tunnels
Layer 3 Network	• IP • OSPF	• CLNP[8] • ES-IS[9] • IS-IS[10]		
Layer 2 Data link	• PPP	• PPP • LAP-D[11]		
Layer 1 Physical	DCC, LAN, fiber, electrical	DCC, LAN, fiber, electrical		—

1. TARP = TID Address Resolution Protocol
2. FTAM = File Transfer and Access Management
3. ACSE = Association-control service element
4. T–TD = TL1–Translation Device
5. FT–TD = File Transfer—Translation Device
6. PST = Presentation layer
7. CLNS = Connectionless Network Layer Service
8. CLNP = Connectionless Network Layer Protocol
9. ES-IS = End System-to-Intermediate System
10. IS-IS = Intermediate System-to-Intermediate System
11. LAP-D = Link Access Protocol on the D Channel

9.7.1 Point-to-Point Protocol

PPP is a data link (Layer 2) encapsulation protocol that transports datagrams over point-to-point links. Although PPP was developed to transport IP traffic, it can carry other protocols including the OSI CLNP. PPP components used in the transport of OSI include:

- High-level data link control (HDLC)—Performs the datagram encapsulation for transport across point-to-point links.
- Link control protocol (LCP)—Establishes, configures, and tests the point-to-point connections.

CTC automatically enables IP over PPP whenever you create an SDCC or LDCC. The SDCC or LDCC can be provisioned to support OSI over PPP.

9.7.2 Link Access Protocol on the D Channel

LAP-D is a data link protocol used in the OSI protocol stack. LAP-D is assigned when you provision an ONS 15600 SDCC as OSI-only. Provisionable LAP-D parameters include:

- Transfer Service—One of the following transfer services must be assigned:
  - Acknowledged Information Transfer Service (AITS)—(Default) Does not exchange data until a logical connection between two LAP-D users is established. This service provides reliable data transfer, flow control, and error control mechanisms.
  - Unacknowledged Information Transfer Service (UITS)—Transfers frames containing user data with no acknowledgement. The service does not guarantee that the data presented by one user will be delivered to another user, nor does it inform the user if the delivery attempt fails. It does not provide any flow control or error control mechanisms.
- Mode—LAP-D is set to either Network or User mode. This parameter sets the LAP-D frame command/response (C/R) value, which indicates whether the frame is a command or a response.
- Maximum transmission unit (MTU)—The LAP-D N201 parameter sets the maximum number of octets in a LAP-D information frame. The range is 512 to 1500 octets.

Note The MTU must be the same size for all NEs on the network.

- Transmission Timers—The following LAP-D timers can be provisioned:
  - The T200 timer sets the timeout period for initiating retries or declaring failures.
  - The T203 timer provisions the maximum time between frame exchanges, that is, the trigger for transmission of the LAP-D “keep-alive” Receive Ready (RR) frames.

Fixed values are assigned to the following LAP-D parameters:

- Terminal Endpoint Identifier (TEI)—A fixed value of 0 is assigned.
- Service Access Point Identifier (SAPI)—A fixed value of 62 is assigned.
- N200 supervisory frame retransmissions—A fixed value of 3 is assigned.

9.7.3 OSI Connectionless Network Service

OSI connectionless network service is implemented by using the Connectionless Network Protocol (CLNP) and Connectionless Network Service (CLNS). CLNP and CLNS are described in the ISO 8473 standard. CLNS provides network layer services to the transport layer through CLNP. CLNS does not perform connection setup or termination because paths are determined independently for each packet that is transmitted through a network. CLNS relies on transport layer protocols to perform error detection and correction.

CLNP is an OSI network layer protocol that carries upper-layer data and error indications over connectionless links. CLNP provides the interface between the CLNS and upper layers. CLNP performs many of the same services for the transport layer as IP. The CLNP datagram is very similar to the IP datagram. It provides mechanisms for fragmentation (data unit identification, fragment/total length, and offset). Like IP, a checksum computed on the CLNP header verifies that the information used to process the CLNP datagram is transmitted correctly, and a lifetime control mechanism (Time to Live) limits the amount of time a datagram is allowed to remain in the system.

CLNP uses network service access points (NSAPs) to identify network devices. The CLNP source and destination addresses are NSAPs. In addition, CLNP uses a network element title (NET) to identify a network-entity in an end system (ES) or intermediate system (IS). NETs are allocated from the same name space as NSAP addresses. Whether an address is an NSAP address or a NET depends on the network selector value in the NSAP.

The ONS 15600 supports the ISO Data Country Code (ISO-DCC) NSAP address format as specified in ISO 8348. The NSAP address is divided into an initial domain part (IDP) and a domain-specific part (DSP). NSAP fields are shown in Table 9-9. NSAP field values are in hexadecimal format. All NSAPs are editable. Shorter NSAPs can be used. However NSAPs for all NEs residing within the same OSI network area usually have the same NSAP format.

Table 9-9 NSAP Fields

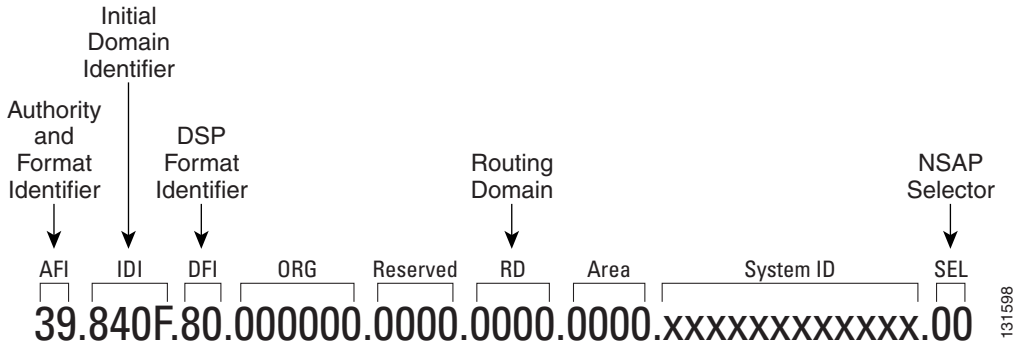
Field	Definition	Description
IDP		
AFI	Authority and format identifier	Specifies the NSAP address format. The initial value is 39 for the ISO-DCC address format.
IDI	Initial domain identifier	Specifies the country code. The initial value is 840F, the United States country code padded with an F.
DSP		
DFI	DSP format identifier	Specifies the DSP format. The initial value is 80, indicating the DSP format follows American National Standards Institute (ANSI) standards.
ORG	Organization	Organization identifier. The initial value is 000000.
Reserved	Reserved	Reserved NSAP field. The Reserved field is normally all zeros (0000).
RD	Routing domain	Defines the routing domain. The initial value is 0000.
AREA	Area	Identifies the OSI routing area to which the node belongs. The initial value is 0000.

Table 9-9 NSAP Fields (continued)

Field	Definition	Description
System	System identifier	The ONS 15600 system identifier is set to its IEEE 802.3 MAC address. Each ONS 15600 supports twelve OSI virtual routers. Each router NSAP system identifier is the ONS 15600 IEEE 802.3 MAC address + *n*, where *n* = 0 to 2. For the primary virtual router, *n* = 0.
SEL	Selector	The selector field directs the protocol data units (PDUs) to the correct destination using the CLNP network layer service. Selector values supported by the ONS 15600 include: • 00—Network Entity Title (NET). Used to exchange PDUs in the ES-IS and IS-IS routing exchange protocols. (See the "9.7.4.1 End System-to-Intermediate System Protocol" section on page 9-32, and "9.7.4.2 Intermediate System-to-Intermediate System" section on page 9-32.) • 1D—Selector for Transport Class 4 (and for FTAM and TL1 applications (Telcordia GR-253-CORE standard) • AF—Selector for the TARP protocol (Telcordia GR-253-CORE standard) • 2F—Selector for the GRE IP-over-CLNS tunnel (ITU/RFC standard) • CC—Selector for the Cisco IP-over-CLNS tunnels (Cisco specific) • E0—Selector for the OSI ping application (Cisco specific) NSELs are only advertised when the node is configured as an ES. They are not advertised when a node is configured as an IS. Tunnel NSELs are not advertised until a tunnel is created.

Figure 9-20 shows the ISO-DCC NSAP address with the default values delivered with the ONS 15600. The System ID is automatically populated with the node MAC address.

Figure 9-20 ISO-DCC NSAP Address



The ONS 15600 main NSAP address is shown on the node view Provisioning > OSI > Main Setup subtab. This address is also the Router 1 primary manual area address, which is viewed and edited on Provisioning > OSI > Routers subtab. See the "9.7.7 OSI Virtual Routers" section on page 9-37 for information about the OSI router and manual area addresses in CTC.

9.7.4 OSI Routing

OSI architecture includes ESs and ISs. The OSI routing scheme includes:

- A set of routing protocols that allow ESs and ISs to collect and distribute the information necessary to determine routes. Protocols include the ES-IS and IS-IS protocols. ES-IS routing establishes connectivity and reach ability among ESs and ISs attached to the same (single) subnetwork.
- A routing information base (RIB) containing this information, from which routes between ESs can be computed. The RIB consists of a table of entries that identify a destination (for example, an NSAP), the subnetwork over which packets should be forwarded to reach that destination, and a routing metric. The routing metric communicates characteristics of the route (such as delay properties or expected error rate) that are used to evaluate the suitability of a route compared to another route with different properties, for transporting a particular packet or class of packets.
- A routing algorithm, Shortest Path First (SPF), that uses information contained in the RIB to derive routes between ESs.

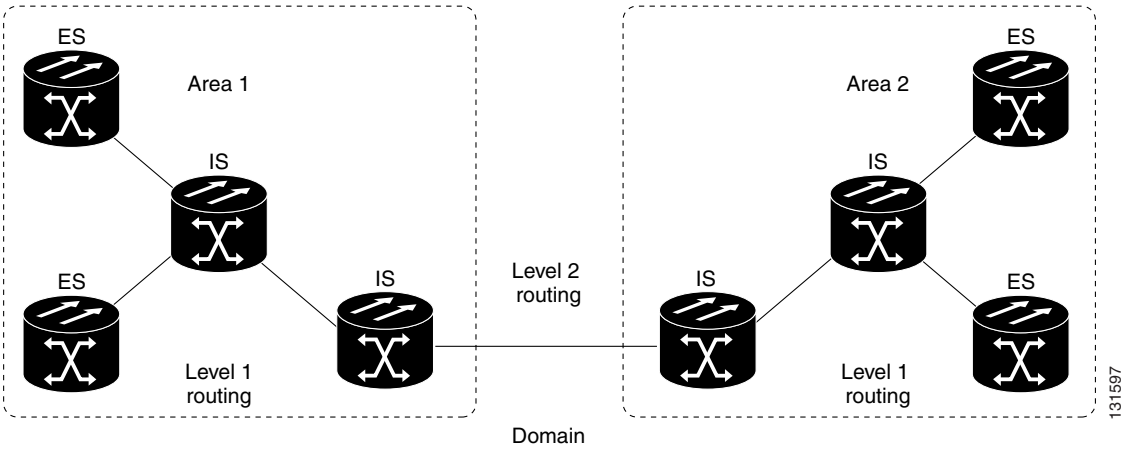
In OSI networking, discovery is based on announcements. An ES uses the ES-IS protocol end system hello (ESH) message to announce its presence to ISs and ESs connected to the same network. Any ES or IS that is listening for ESHs gets a copy. ISs store the NSAP address and the corresponding subnetwork address pair in routing tables. ESs might store the address, or they might wait to be informed by ISs when they need such information.

An IS composes intermediate system hello (ISH) messages to announce its configuration information to ISs and ESs that are connected to the same broadcast subnetwork. Like the ESHs, the ISH contains the addressing information for the IS (the NET and the subnetwork point-of-attachment address [SNPA]) and a holding time. ISHs might also communicate a suggested ES configuration time recommending a configuration timer to ESs.

The exchange of ISHs is called neighbor greeting or initialization. Each router learns about the other routers with which they share direct connectivity. After the initialization, each router constructs a link-state packet (LSP). The LSP contains a list of the names of the IS's neighbors and the cost to reach each of the neighbors. Routers then distribute the LSPs to all of the other routers. When all LSPs are propagated to all routers, each router has a complete map of the network topology (in the form of LSPs). Routers use the LSPs and the SPF algorithm to compute routes to every destination in the network.

OSI networks are divided into areas and domains. An area is a group of contiguous networks and attached hosts that is designated as an area by a network administrator. A domain is a collection of connected areas. Routing domains provide full connectivity to all ESs within them. Routing within the same area is known as Level 1 routing. Routing between two areas is known as Level 2 routing. LSPs that are exchanged within a Level 1 area are called L1 LSPs. LSPs that are exchanged across Level 2 areas are called L2 LSPs. Figure 9-21 shows an example of Level 1 and Level 2 routing.

Figure 9-21 Level 1 and Level 2 OSI Routing



When you provision an ONS 15600 for a network with NEs that use both the TCP/IP and OSI protocol stacks, you will provision it as one of the following:

- Intermediate System Level 1—The ONS 15600 performs OSI IS functions. It communicates with IS and ES nodes that reside within its OSI area. It depends upon an IS L1/L2 node to communicate with IS and ES nodes that reside outside its OSI area.
- Intermediate System Level 1/Level 2—The ONS 15600 performs IS functions. It communicates with IS and ES nodes that reside within its OSI area. It also communicates with IS L1/L2 nodes that reside in other OSI areas. This option should not be provisioned unless the node is connected to another IS L1/L2 node that resides in a different OSI area. The node must also be connected to all nodes within its area that are provisioned as IS L1/L2.

9.7.4.1 End System-to-Intermediate System Protocol

ES-IS is an OSI protocol that defines how ESs (hosts) and ISs (routers) learn about each other. ES-IS configuration information is transmitted at regular intervals through the ES and IS hello messages. The hello messages contain the subnetwork and network layer addresses of the systems that generate them.

The ES-IS configuration protocol communicates both OSI network layer addresses and OSI subnetwork addresses. OSI network layer addresses identify either the NSAP, which is the interface between OSI Layer 3 and Layer 4, or the NET, which is the network layer entity in an OSI IS. OSI SNPAs are the points at which an ES or IS is physically attached to a subnetwork. The SNPA address uniquely identifies each system attached to the subnetwork. In an Ethernet network, for example, the SNPA is the 48-bit MAC address. Part of the configuration information transmitted by ES-IS is the NSAP-to-SNPA or NET-to-SNPA mapping.

9.7.4.2 Intermediate System-to-Intermediate System

IS-IS is an OSI link-state hierarchical routing protocol that floods the network with link-state information to build a complete, consistent picture of a network topology. IS-IS distinguishes between Level 1 and Level 2 ISs. Level 1 ISs communicate with other Level 1 ISs in the same area. Level 2 ISs route between Level 1 areas and form an intradomain routing backbone. Level 1 ISs need to know only how to get to the nearest Level 2 IS. The backbone routing protocol can change without impacting the intra-area routing protocol.

OSI routing begins when the ESs discover the nearest IS by listening to ISH packets. When an ES wants to send a packet to another ES, it sends the packet to one of the ISs on its directly attached network. The router then looks up the destination address and forwards the packet along the best route. If the destination ES is on the same subnetwork, the local IS knows this from listening to ESHs and forwards the packet appropriately. The IS also might provide a redirect (RD) message back to the source to tell it that a more direct route is available. If the destination address is an ES on another subnetwork in the same area, the IS knows the correct route and forwards the packet appropriately. If the destination address is an ES in another area, the Level 1 IS sends the packet to the nearest Level 2 IS. Forwarding through Level 2 ISs continues until the packet reaches a Level 2 IS in the destination area. Within the destination area, the ISs forward the packet along the best path until the destination ES is reached.

Link-state update messages help ISs learn about the network topology. Each IS generates an update specifying the ESs and ISs to which it is connected, as well as the associated metrics. The update is then sent to all neighboring ISs, which forward (flood) it to their neighbors, and so on. (Sequence numbers terminate the flood and distinguish old updates from new ones.) Using these updates, each IS can build a complete topology of the network. When the topology changes, new updates are sent.

IS-IS uses a single required default metric with a maximum path value of 1024. The metric is arbitrary and typically is assigned by a network administrator. Any single link can have a maximum value of 64, and path links are calculated by summing link values. Maximum metric values were set at these levels to provide the granularity to support various link types while at the same time ensuring that the shortest-path algorithm used for route computation is reasonably efficient. Three optional IS-IS metrics (costs)—delay, expense, and error—are not supported by the ONS 15600. IS-IS maintains a mapping of the metrics to the quality of service (QoS) option in the CLNP packet header. IS-IS uses the mappings to compute routes through the internetwork.

9.7.5 TARP

TARP is used when TL1 target identifiers (TIDs) must be translated to NSAP addresses. The TID-to-NSAP translation occurs by mapping TIDs to the NETs, then deriving NSAPs from the NETs by using the NSAP selector values (Table 9-9 on page 9-29).

TARP uses a selective PDU propagation methodology in conjunction with a distributed database (that resides within the NEs) of TID-to-NET mappings. TARP allows NEs to translate between TID and NET by automatically exchanging mapping information with other NEs. The TARP PDU is carried by the standard CLNP Data PDU. TARP PDU fields are shown in Table 9-10.

Table 9-10 TARP PDU Fields

Field	Abbreviation	Size (bytes)	Description
TARP Lifetime	tar-lif	2	The TARP time-to-live in hops.
TARP Sequence Number	tar-seq	2	The TARP sequence number used for loop detection.
Protocol Address Type	tar-pro	1	Used to identify the type of protocol address that the TID must be mapped to. The value FE is used to identify the CLNP address type.
TARP Type Code	tar-tcd	1	The TARP Type Code identifies the TARP type of PDU. Five TARP types, shown in Table 9-11, are defined.
TID Target Length	tar-tln	1	The number of octets that are in the tar-ttg field.

Table 9-10 TARP PDU Fields (continued)

Field	Abbreviation	Size (bytes)	Description
TID Originator Length	tar-oln	1	The number of octets that are in the tar-tor field.
Protocol Address Length	tar-pln	1	The number of octets that are in the tar-por field.
TID of Target	tar-ttg	*n* = 0, 1, 2...	TID value for the target NE.
TID of Originator	tar-tor	*n* = 0, 1, 2...	TID value of the TARP PDU originator.
Protocol Address of Originator	tar-por	*n* = 0, 1, 2...	Protocol address (for the protocol type identified in the tar-pro field) of the TARP PDU originator. When the tar-pro field is set to FE (hex), tar-por will contain a CLNP address (that is, the NET).

Table 9-11 shows the TARP PDUs types that govern TARP interaction and routing.

Table 9-11 TARP PDU Types

Type	Description	Procedure
1	Sent when a device has a TID for which it has no matching NSAP.	After an NE originates a TARP Type 1 PDU, the PDU is sent to all adjacencies within the NE's routing area.
2	Sent when a device has a TID for which it has no matching NSAP and no response was received from the Type 1 PDU.	After an NE originates a TARP Type 2 PDU, the PDU is sent to all Level 1 and Level 2 neighbors.
3	Sent as a response to Type 1, Type 2, or Type 5 PDUs.	After a TARP Request (Type 1 or 2) PDU is received, a TARP Type 3 PDU is sent to the request originator. Type 3 PDUs do not use the TARP propagation procedures.
4	Sent as a notification when a change occurs locally, for example, a TID or NSAP change. It might also be sent when an NE initializes.	A Type 4 PDU is a notification of a TID or Protocol Address change at the NE that originates the notification. The PDU is sent to all adjacencies inside and outside the NE's routing area.
5	Sent when a device needs a TID that corresponds to a specific NSAP.	When a Type 5 PDU is sent, the CLNP destination address is known, so the PDU is sent to only that address. Type 5 PDUs do not use the TARP propagation procedures.

9.7.5.1 TARP Processing

A TARP data cache (TDC) is created at each NE to facilitate TARP processing. In CTC, the TDC is displayed and managed on the node view Maintenance > OSI > TDC subtab. The TDC subtab contains the following TARP PDU fields:

- TID—TID of the originating NE (tar-tor).
- NSAP—NSAP of the originating NE.

- Type— Indicates whether the TARP PDU was created through the TARP propagation process (dynamic) or manually created (static).

Provisionable timers, shown in Table 9-12, control TARP processing.

Table 9-12 TARP Timers

Timer	Description	Default (seconds)	Range (seconds)
T1	Waiting for response to TARP Type 1 Request PDU	15	0–3600
T2	Waiting for response to TARP Type 2 Request PDU	25	0–3600
T3	Waiting for response to address resolution request	40	0–3600
T4	Timer starts when T2 expires (used during error recovery)	20	0–3600

Table 9-13 shows the main TARP processes and the general sequence of events that occurs in each process.

Table 9-13 TARP Processing Flow

Process	General TARP Flow
Find a NET that matches a TID	1. TARP checks its TDC for a match. If a match is found, TARP returns the result to the requesting application. 2. If no match is found, a TARP Type 1 PDU is generated and Timer T1 is started. 3. If Timer T1 expires before a match if found, a Type 2 PDU is generated and Timer T2 is started. 4. If Timer T2 expires before a match is found, Timer T4 is started. 5. If Timer T4 expires before a match is found, a Type 2 PDU is generated and Timer T2 is started.
Find a TID that matches a NET	A Type 5 PDU is generated. Timer T3 is used. However, if the timer expires, no error recovery procedure occurs, and a status message is provided to indicate that the TID cannot be found.
Send a notification of TID or protocol address change	TARP generates a Type 4 PDU in which the tar-ttg field contains the NE's TID value that existed prior to the change of TID or protocol address. Confirmation that other NEs successfully received the address change is not sent.

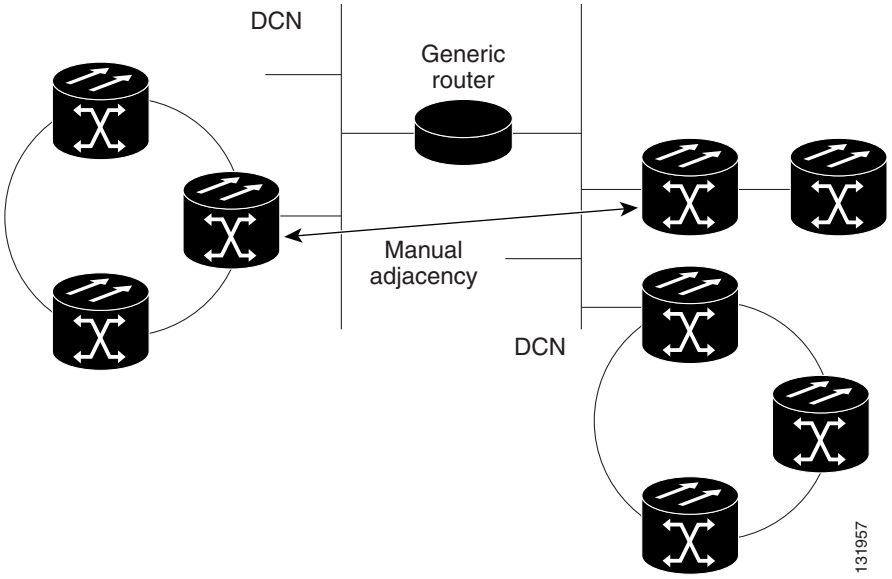
9.7.5.2 TARP Loop Detection Buffer

The TARP loop detection buffer (LDB) can be enabled to prevent duplicate TARP PDUs from entering the TDC. When a TARP Type 1, 2, or 4 PDU arrives, TARP checks its LDB for a NET address (tar-por) of the PDU originator match. If no match is found, TARP processes the PDU and assigns a tar-por, tar-seq (sequence) entry for the PDU to the LDB. If the tar-seq is zero, a timer associated with the LDB entry is started using the provisionable LDB entry timer on the node view OSI > TARP > Config tab. If a match exists, the tar-seq is compared to the LDB entry. If the tar-seq is not zero and is less than or equal to the LDB entry, the PDU is discarded. If the tar-seq is greater than the LDB entry, the PDU is processed and the tar-seq field in the LDB entry is updated with the new value. The ONS 15600 LDB holds approximately 500 entries. The LDB is flushed periodically based on the time set in the LDB Flush timer on the node view OSI > TARP > Config tab.

9.7.5.3 Manual TARP Adjacencies

TARP adjacencies can be manually provisioned in networks where ONS 15600s must communicate across routers or non-SONET NEs that lack TARP capability. In CTC, manual TARP adjacencies are provisioned on the node view Provisioning > OSI > TARP > MAT (Manual Area Table) subtab. The manual adjacency causes a TARP request to hop through the general router or non-SONET NE, as shown in Figure 9-22.

Figure 9-22 Manual TARP Adjacencies



9.7.5.4 Manual TID to NSAP Provisioning

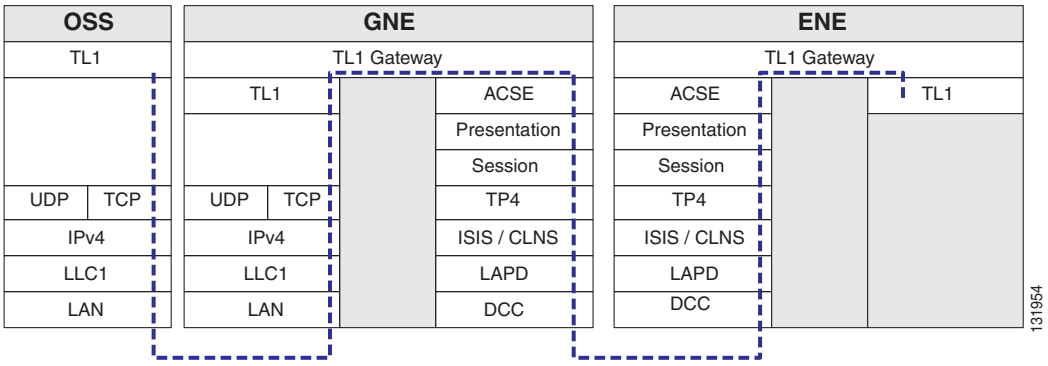
TIDs can be manually linked to NSAPs and added to the TDC. Static TDC entries are similar to static routes. For a specific TID, you force a specific NSAP. Resolution requests for that TID always return that NSAP. No TARP network propagation or instantaneous replies are involved. Static entries allow you to forward TL1 commands to NEs that do not support TARP. However, static TDC entries are not dynamically updated, so outdated entries are not removed after the TID or the NSAP changes on the target node.

9.7.6 TCP/IP and OSI Mediation

Two mediation processes facilitate TL1 networking and file transfers between NEs and ONS client computers running TCP/IP and OSI protocol suites:

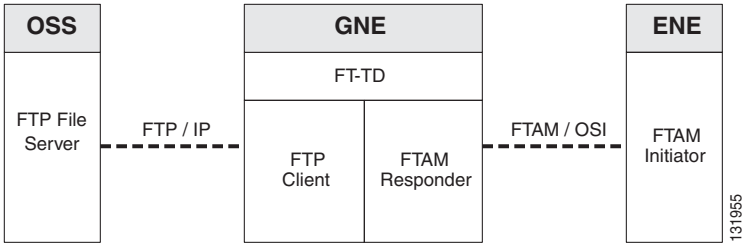
- T–TD—Performs a TL1-over-IP to TL1-over-OSI gateway mediation to enable an IP-based OSS to manage OSI-only NEs subtended from a GNE. Figure 9-23 shows the T–TD protocol flow.

Figure 9-23 T–TD Protocol Flow



- FT–TD—Performs an FTP conversion between FTAM and FTP. The FT–TD gateway entity includes an FTAM responder (server) and an FTP client, allowing FTAM initiators (clients) to store, retrieve, or delete files from an FTP server. The FT–TD gateway is unidirectional and is driven by the FTAM initiator. The FT–TD FTAM responder exchanges messages with the FTAM initiator over the full OSI stack. Figure 9-24 shows the FT–TD protocol flow.

Figure 9-24 FT–TD Protocol Flow



The ONS 15600 uses FT–TD for the following file transfer processes:

- Software downloads
- Database backups and restores

9.7.7 OSI Virtual Routers

The ONS 15600 supports twelve OSI virtual routers. The routers are provisioned on the Provisioning > OSI > Routers tab. Each router has an editable manual area address and a unique NSAP System ID that is set to the node MAC address + *n*. For Router 1, *n* = 0. For Router 2, *n* = 1. For Router 3, *n* = 2, and for Router12, n = 11. Each router can be enabled and connected to different OSI routing areas. However, Router 1 is the primary router, and it must be enabled before Routers 2 through 12 can be enabled. The Router 1 manual area address and System ID create the NSAP address assigned to the node's TID. In addition, Router 1 supports OSI TARP, mediation, and tunneling functions that are not supported by Routers 2 through 12. These include:

- TID-to-NSAP resolution
- TARP data cache
- IP-over-CLNS tunnels
- FTAM

- FT-TD
- T-TD
- LAN subnet

OSI virtual router constraints depend on the routing mode provisioned for the node. Table 9-14 shows the number of IS L1s, IS L1/L2s, and DCCs that are supported by each router. An IS L1 and IS L1/L2 support one ES per DCC subnet and up to 100 ESs per LAN subnet.

Table 9-14 OSI Virtual Router Constraints

Routing Mode	Router 1	Router 2 — 12	IS L1 per area	IS L1/L2 per area	DCC per IS
IS L1	Yes	Yes	250	—	60
IS L1/L2	Yes	Yes	250	50	60

Each OSI virtual router has a primary manual area address. You can also create two additional manual area addresses. These manual area addresses can be used to:

- Split up an area—Nodes within a given area can accumulate to a point that they are difficult to manage, cause excessive traffic, or threaten to exceed the usable address space for an area. Additional manual area addresses can be assigned so that you can smoothly partition a network into separate areas without disrupting service.
- Merge areas—Use transitional area addresses to merge as many as three separate areas into a single area that shares a common area address.
- Change to a different address—You might need to change an area address for a particular group of nodes. Use multiple manual area addresses to allow incoming traffic intended for an old area address to continue being routed to associated nodes.

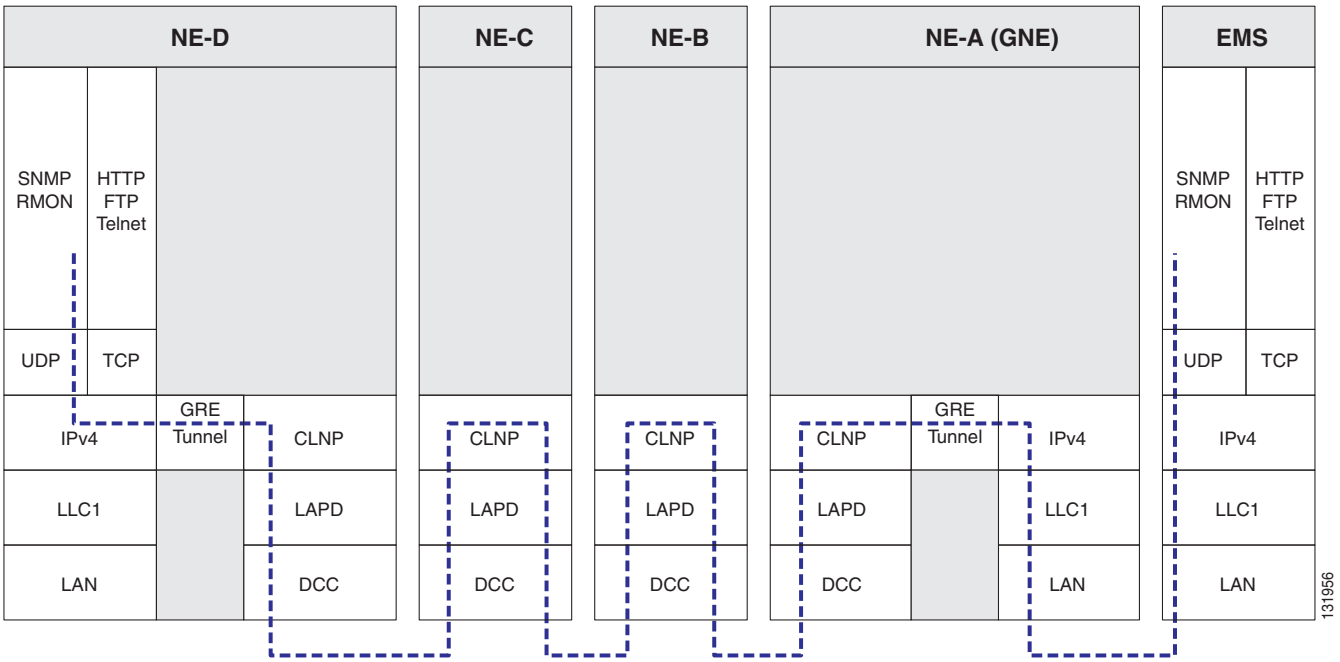
9.7.8 IP-over-CLNS Tunnels

IP-over-CLNS tunnels are used to encapsulate IP for transport across OSI NEs. The ONS 15600 supports two tunnel types:

- GRE—Generic Routing Encapsulation is a tunneling protocol that encapsulates one network layer for transport across another. GRE tunnels add both a CLNS header and a GRE header to the tunnel frames. GRE tunnels are supported by Cisco routers and some other vendor NEs.
- Cisco IP—The Cisco IP tunnel directly encapsulates the IP packet with no intermediate header. Cisco IP is supported by most Cisco routers.

Figure 9-25 shows the protocol flow when an IP-over-CLNS tunnel is created through four NEs (A, B, C, and D). The tunnel ends are configured on NEs A and D, which support both IP and OSI. NEs B and C only support OSI, so they only route the OSI packets.

Figure 9-25 IP-over-CLNS Tunnel Flow



9.7.8.1 Provisioning IP-over-CLNS Tunnels

IP-over-CLNS tunnels must be carefully planned to prevent nodes from losing visibility or connectivity. Before you begin a tunnel, verify that the tunnel type, either Cisco IP or GRE, is supported by the equipment at the other end. Always verify IP and NSAP addresses. Provisioning of IP-over-CLNS tunnels in CTC is performed on the node view Provisioning > OSI > IP over CLNS Tunnels tab. For procedures, refer to the "Turn Up Node" chapter in the *ONS 15600 Procedures Guide*.

Provisioning IP-over-CLNS tunnels on Cisco routers requires the following prerequisite tasks, as well as other OSI provisioning:

- (Required) Enable IS-IS
- (Optional) Enable routing for an area on an interface
- (Optional) Assign multiple area addresses
- (Optional) Configure IS-IS interface parameters
- (Optional) Configure miscellaneous IS-IS parameters

The Cisco IOS commands used to create IP-over-CLNS tunnels (CTunnels) are shown in Table 9-15.

Table 9-15 IP Over CLNS Tunnel IOS Commands

Step	Step	Purpose
1	Router (config) # **interface ctunnel** *interface-number*	Creates a virtual interface to transport IP over a CLNS tunnel and enters interface configuration mode. The interface number must be unique for each CTunnel interface.
2	Router (config-if # **ctunnel destination** *remote-nsap-address*	Configures the destination parameter for the CTunnel. Specifies the destination NSAP1 address of the CTunnel, where the IP packets are extracted.
3	Router (config-if) # **ip address** *ip-address mask*	Sets the primary or secondary IP address for an interface.

If you are provisioning an IP-over-CLNS tunnel on a Cisco router, always follow procedures provided in the Cisco IOS documentation for the router you are provisioning. For information about ISO CLNS provisioning including IP-over-CLNS tunnels, see the "Configuring ISO CLNS" chapter in the *Cisco IOS Apollo Domain, Banyon VINES, DECnet, ISO CLNS, and XNS Configuration Guide*.

9.7.8.2 IP-Over-CLNS Tunnel Scenario 1: ONS Node to Other Vendor GNE

Figure 9-26 shows an IP-over-CLNS tunnel created from an ONS node to another vendor GNE. The other vendor NE has an IP connection to an IP DCN to which a CTC computer is attached. An OSI-only (LAP-D) SDCC and a GRE tunnel are created between the ONS NE 1 to the other vender GNE.

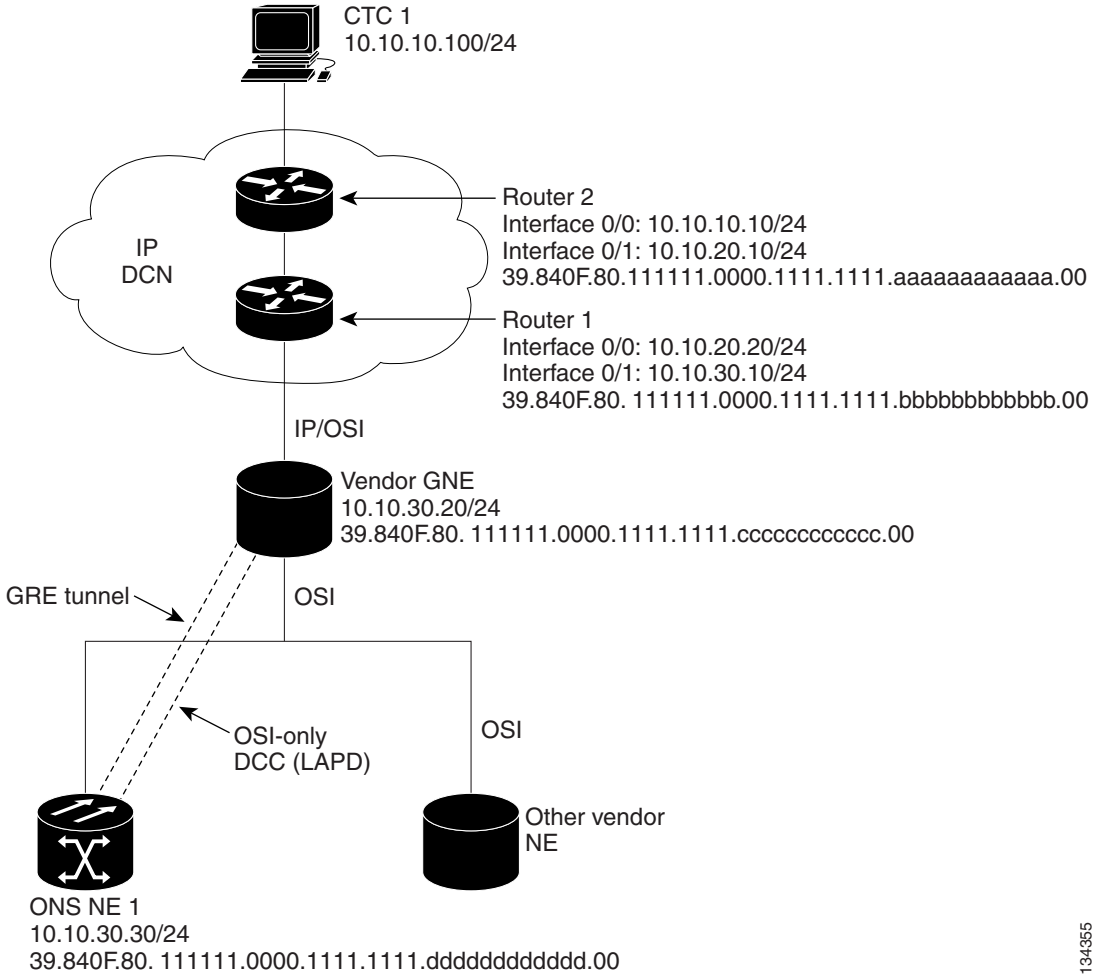
IP-over-CLNS tunnel on the ONS NE 1:

- Destination: 10.10.10.100 (CTC 1)
- Mask: 255.255.255.255 for host route (CTC 1 only), or 255.255.255.0 for subnet route (all CTC computers residing on the 10.10.10.0 subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.ccccccccccc.00 (other vendor GNE)
- Metric: 110
- Tunnel Type: GRE

IP-over-CLNS tunnel on the other vender GNE:

- Destination: 10.20.30.30 (ONS NE 1)
- Mask: 255.255.255.255 for host route (ONS NE 1 only), or 255.255.255.0 for subnet route (all ONS nodes residing on the 10.30.30.0 subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.ddddddddddd.00 (ONS NE 1)
- Metric: 110
- Tunnel Type: GRE

Figure 9-26 IP Over CLNS Tunnel Scenario 1: ONS NE to Other Vender GNE



9.7.8.3 IP-Over-CLNS Tunnel Scenario 2: ONS Node to Router

Figure 9-27 shows an IP-over-CLNS tunnel from an ONS node to a router. The other vendor NE has an OSI connection to a router on an IP DCN, to which a CTC computer is attached. An OSI-only (LAP-D) SDCC is created between the ONS NE 1 and the other vender GNE. The OSI over IP tunnel can be either the Cisco IP tunnel or a GRE tunnel, depending on the tunnel types supported by the router.

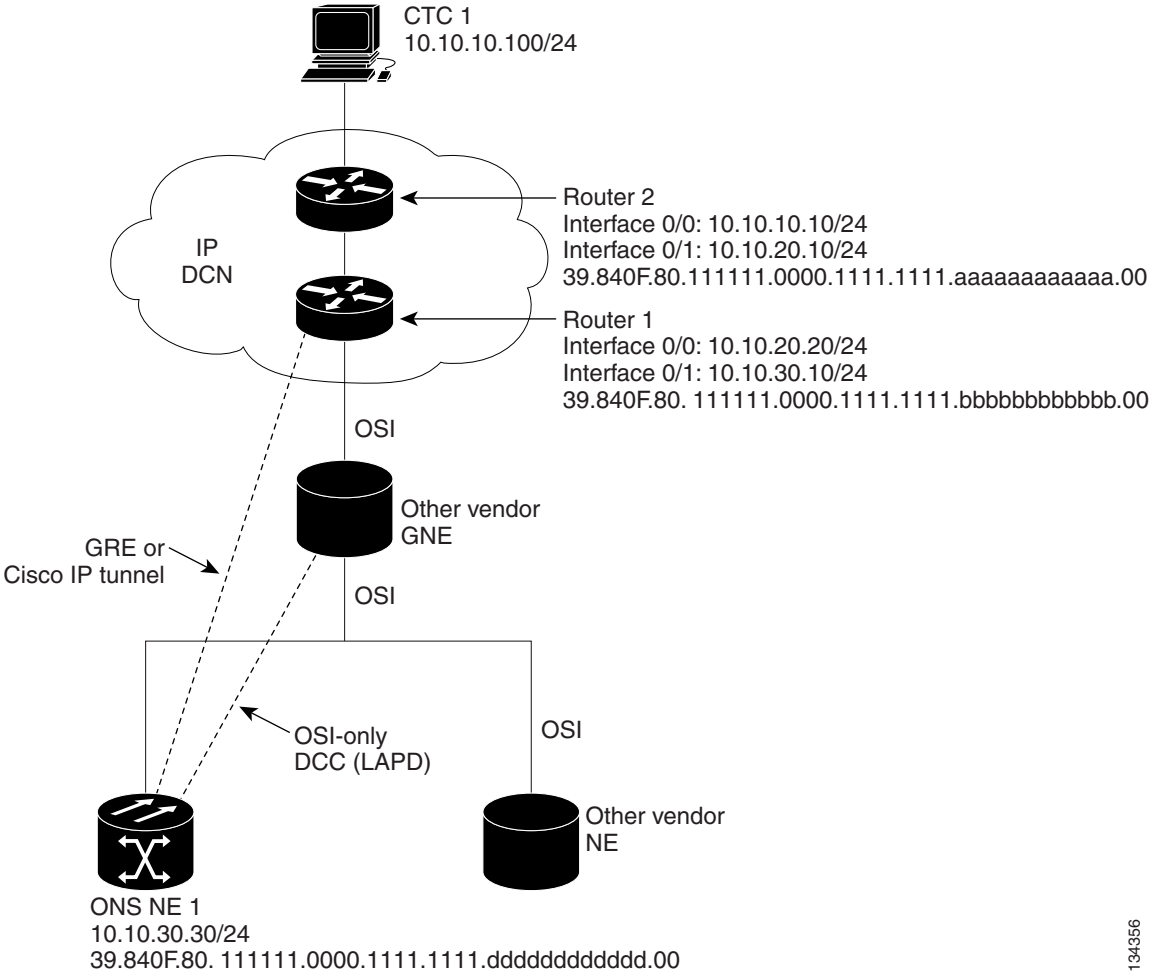
IP-over-CLNS tunnel on ONS NE 1:

- Destination: 10.10.30.10 (Router 1, Interface 0/1)
- Mask: 255.255.255.255 for host route (Router 1 only), or 255.255.255.0 for subnet route (all routers on the same subnet)
- NSAP: 39.840F.80.1111.0000.1111.1111.bbbbbbbbbbbb.00 (Router 1)
- Metric: 110
- Tunnel Type: Cisco IP

CTunnel (IP over CLNS) on Router 1:

```
ip routing
clns routing
interface ctunnel 102
    ip address 10.10.30.30 255.255.255.0
    ctunnel destination 39.840F.80.1111.0000.1111.1111.dddddddddddd.00
interface Ethernet0/1
    clns router isis
router isis
    net 39.840F.80.1111.0000.1111.1111.bbbbbbbbbbbb.00
```

Figure 9-27 IP Over CLNS Tunnel Scenario 2: ONS Node to Router



9.7.8.4 IP-Over-CLNS Tunnel Scenario 3: ONS Node to Router Across an OSI DCN

Figure 9-28 shows an IP-over-CLNS tunnel from an ONS node to a router across an OSI DCN. The other vendor NE has an OSI connection to an IP DCN to which a CTC computer is attached. An OSI-only (LAP-D) SDCC is created between the ONS NE 1 and the other vender GNE. The OSI over IP tunnel can be either the Cisco IP tunnel or a GRE tunnel, depending on the tunnel types supported by the router.

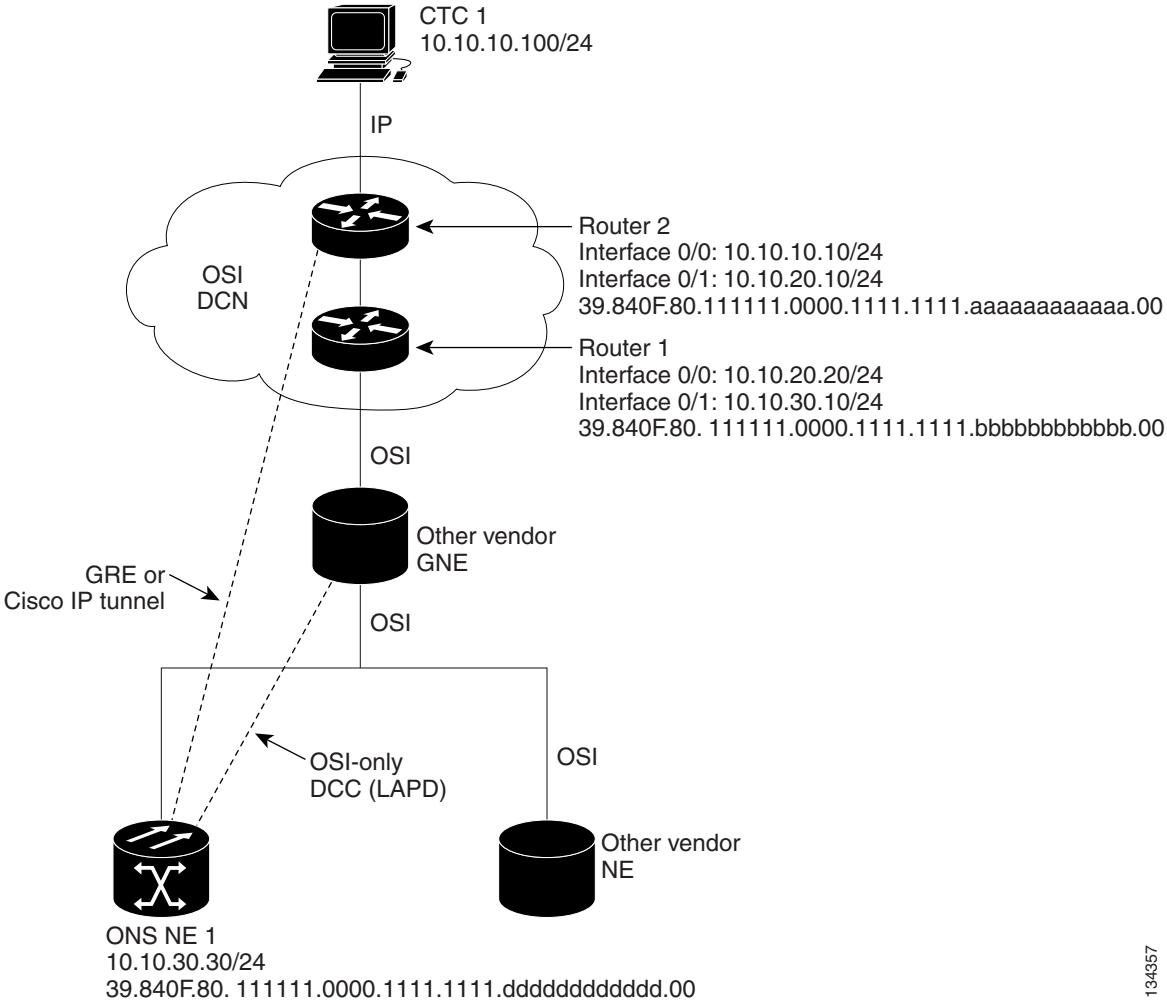
IP-over-CLNS tunnel on ONS NE 1:

- Destination: Router 2 IP address
- Mask: 255.255.255.255 for host route (CTC 1 only), or 255.255.255.0 for subnet route (all CTC computers on the same subnet)
- NSAP: Other vender GNE NSAP address
- Metric: 110
- Tunnel Type: Cisco IP

IP over OSI tunnel on Router 2 (sample Cisco IOS provisioning):

```
ip routing
clns routing
interface ctunnel 102
    ip address 10.10.30.30 255.255.255.0
    ctunnel destination 39.840F.80.1111.0000.1111.1111.ddddddddddd.00
interface Ethernet0/1
    clns router isis
router isis
    net 39.840F.80.1111.0000.1111.1111.aaaaaaaaaaa.00
```

Figure 9-28 IP-Over-CLNS Tunnel Scenario 3: ONS Node to Router Across an OSI DCN



9.7.9 OSI/IP Networking Scenarios

The following eight scenarios show examples of ONS 15600s in networks with OSI-based NEs. The scenarios show ONS 15600s in a variety of roles. The scenarios assume the following:

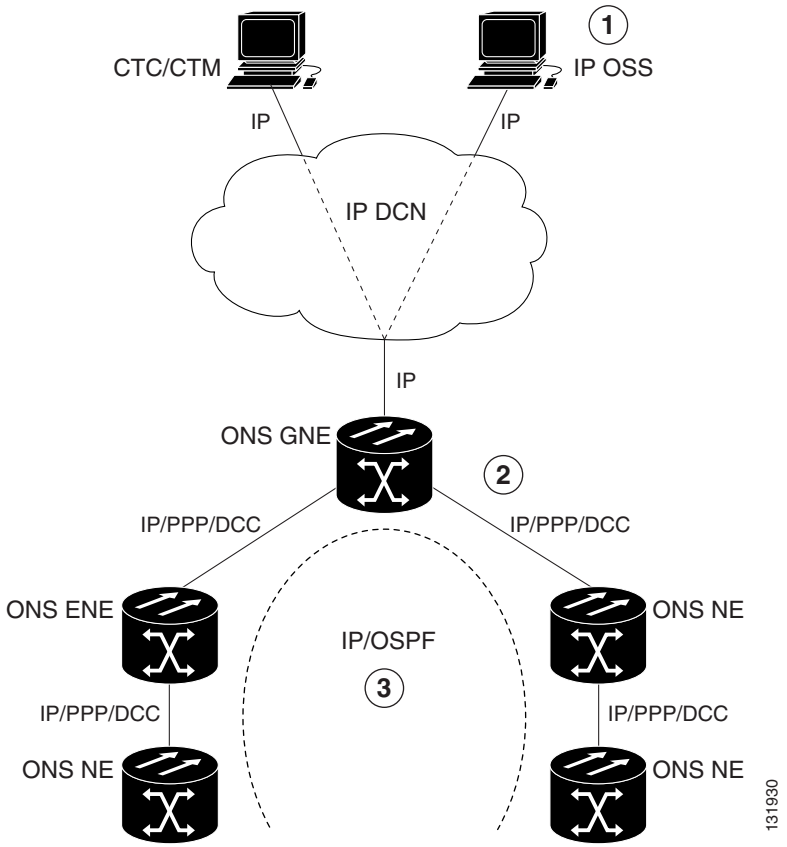
- ONS 15600 NEs are configured as dual OSI and IP nodes with both IP and NSAP addresses. They run both OSPF and OSI (IS-IS or ES-IS) routing protocols as "Ships-In-The-Night," with no route redistribution.
- ONS 15600 NEs run TARP, which allows them to resolve a TL1 TID to a NSAP address. A TID might resolve to both an IP and an NSAP address when the destination TID is an ONS 15600 NE that has both IP and NSAP address.
- DCC links between ONS 15600 NEs and OSI-only NEs run the full OSI stack over LAP-D, which includes IS-IS, ES-IS, and TARP.
- DCC links between ONS 15600 NEs run the full OSI stack and IP (OSPF) over PPP.

- All ONS 15600 NEs participating in an OSI network run OSI over PPP between themselves. This is needed so that other vendor GNEs can route TL1 commands to all ONS 15600 NEs participating in the OSI network.

9.7.9.1 OSI/IP Scenario 1: IP OSS, IP DCN, ONS GNE, IP DCC, and ONS ENE

Figure 9-29 shows OSI/IP Scenario 1, the current ONS 15600 IP-based implementation, with an IP DCN, IP-over-PPP DCC, and OSPF routing.

Figure 9-29 OSI/IP Scenario 1: IP OSS, IP DCN, ONS GNE, IP DCC, and ONS ENE

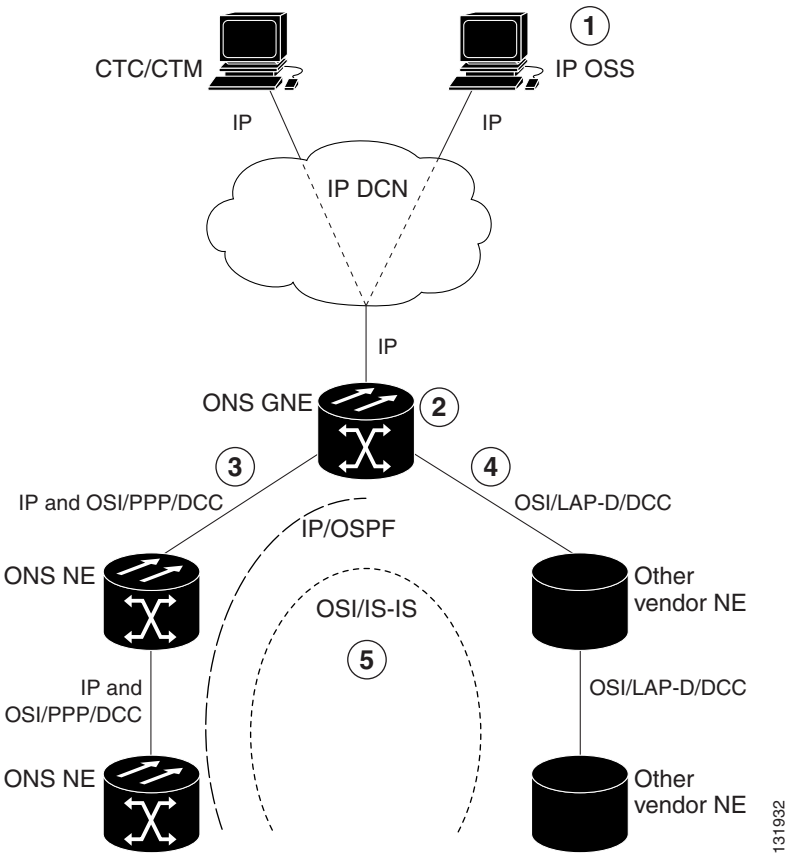


1	IP OSS manages ONS 15600 using TL1 and FTP.
2	DCCs carry IP over the PPP protocol.
3	The ONS 15600 network is managed by IP over OSPF.

9.7.9.2 OSI/IP Scenario 2: IP OSS, IP DCN, ONS GNE, OSI DCC, and Other Vendor ENE

OSI/IP Scenario 2 (Figure 9-30) shows an ONS 15600 GNE in a multivendor OSI network. Both the ONS 15600 GNE and the other vendor NEs are managed by an IP OSS using TL1 and FTP. The ONS 15600 is also managed by CTC and Cisco Transport Manager (CTM). Because the other vendor NE only supports TL1 and FTAM over the full OSI stack, the ONS 15600 GNE provides T–TD and FT–TD mediation to convert TL1/IP to TL1/OSI and FTAM/OSI to FTP/IP.

Figure 9-30 OSI/IP Scenario 2: IP OSS, IP DCN, ONS GNE, OSI DCC, and Other Vendor ENE



1	The IP OSS manages ONS 15600 and other vendor NEs using TL1 and FTP.
2	The ONS 15600 GNE performs mediation for other vendor NEs.
3	DCCs between the ONS 15600 GNE and ONS 15600 NEs are provisioned for IP and OSI over PPP.
4	DCCs between the ONS 15600 GNE and other vendor NEs are provisioned for OSI over LAP-D.
5	The ONS 15600 and the other vendor NE network include IP over OSPF and OSI over the IS-IS protocol.

The ONS 15600 GNE routes TL1 traffic to the correct NE by resolving the TL1 TID to either an IP or NSAP address. For TL1 traffic to other vendor NEs (OSI-only nodes), the TID is resolved to an NSAP address. The ONS 15600 GNE passes the TL1 to the mediation function, which encapsulates it over the full OSI stack and routes it to the destination using the IS-IS protocol.

For TL1 traffic to ONS 15600 NEs, the TID is resolved to both an IP and an NSAP address. The ONS 15600 GNE follows the current TL1 processing model and forwards the request to the destination NE using the TCP/IP stack and OSPF routing.

OSS-initiated software downloads consist of two parts: the OSS to destination NE TL1 download request and the file transfer. The TL1 request is handled the same as described earlier. The ONS 15600 NEs use FTP for file transfers. OSI-only NEs use FTAM to perform file transfers. The FTAM protocol is carried over OSI between the OSI NE and the ONS 15600 GNE. The GNE mediation translates between FTAM to FTP.

9.7.9.3 OSI/IP Scenario 3: IP OSS, IP DCN, Other Vendor GNE, OSI DCC, and ONS ENE

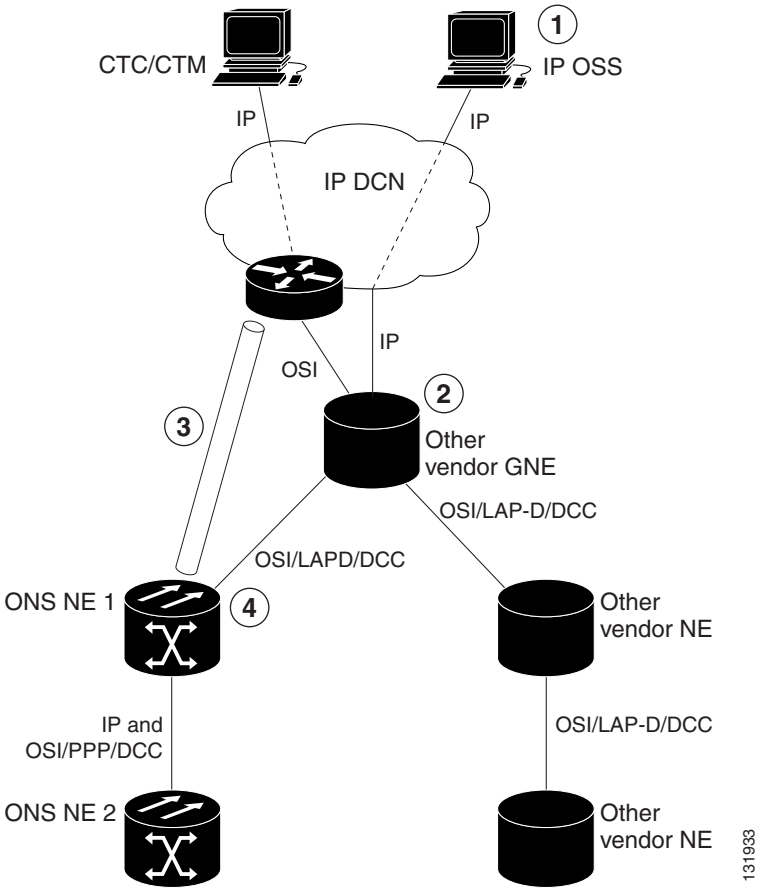
In OSI/IP Scenario 3 (Figure 9-31), all TL1 traffic between the OSS and GNE is exchanged over the IP DCN. TL1 traffic targeted for the GNE is processed locally. All other TL1 traffic is forwarded to the OSI stack, which performs IP-to-OSI TL1 translation. The TL1 is encapsulated in the full OSI stack and sent to the target NE over the DCC. The GNE can route to any node within the IS-IS domain because all NEs, ONS 15600 and non-ONS 15600, have NSAP addresses and support IS-IS routing.

TL1 traffic received by an ONS 15600 NE and not addressed to its NSAP address is forwarded by IS-IS routing to the correct destination. TL1 traffic received by an ONS 15600 NE and addressed to its NSAP is sent up the OSI stack to the mediation function, which extracts the TL1 and passes it to the ONS 15600 TL1 processor.

An OSS initiated software download includes the OSS to destination node TL1 download request and the file transfer. The TL1 request is handled as described earlier. The target node uses FTAM for file transfers because the GNE does not support IP on the DCC and cannot forward FTP. The ONS 15600 NEs therefore must support an FTAM client and initiate file transfer using FTAM when subtended to an OSI GNE.

In this scenario, the GNE has both IP and OSI DCN connections. The GNE only supports TL1 and FTP over IP. Both are translated and then carried over OSI to the destination ENE (ONS 15600 or OSI-only NE). All other IP traffic is discarded by the GNE. The CTC/CTM IP traffic is carried over an IP-over-OSI tunnel to an ONS 15600 NE. The tunnel is created between an external router and an ONS 15600 NE. The traffic is sent to the ONS 15600 terminating the tunnel. That ONS 15600 then forwards the traffic over the tunnel to CTC/CTM by way of the external router.

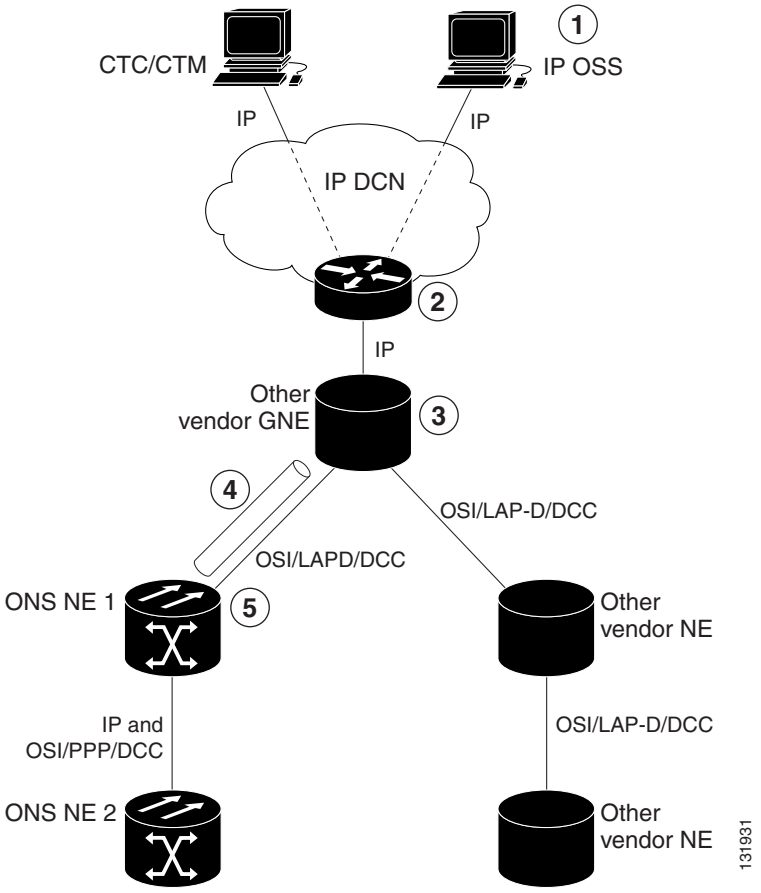
Figure 9-31 OSI/IP Scenario 3: IP OSS, IP DCN, Other Vendor GNE, OSI DCC, and ONS ENE



1	The IP OSS manages the ONS 15600 and other vendor NEs using TL1 and FTP.
2	The other vendor GNE performs mediation for TL1 and FTP, so the DCCs to the ONS 15600 and other vendor NEs are OSI-only.
3	CTC/CTM communicates with ONS 15600 NEs over a IP-over-CLNS tunnel. The tunnel is created from the ONS 15600 node to the external router.
4	The ONS 15600 NE exchanges TL1 over the full OSI stack using FTAM for file transfer.

Figure 9-32 shows the same scenario, except the IP-over-CLNS tunnel endpoint is the GNE and not the DCN router.

Figure 9-32 OSI/IP Scenario 3 with OSI/IP-over-CLNS Tunnel Endpoint at the GNE

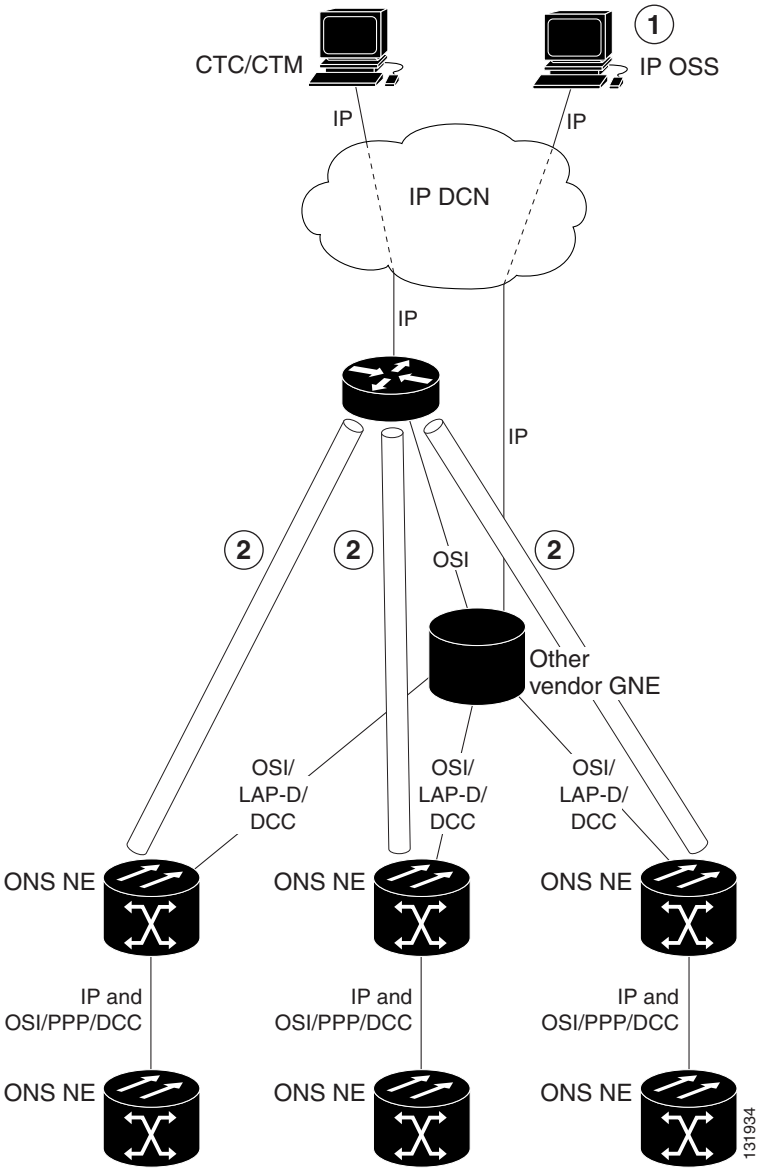


1	The IP OSS manages ONS and other vendor NEs using TL1 and FTP.
2	The router routes requests to the other vender GNE.
3	The other vendor GNE performs mediation for TL1 and FTP, so the DCCs to ONS 15600 and other vendor NEs are OSI-only.
4	CTC/CTM communicates with ONS 15600 NEs over an IP-over-CLNS tunnel between the ONS 15600 and the GNE.
5	ONS 15600 NEs exchange TL1 over the full OSI stack. FTAM is used for file transfer.

9.7.9.4 OSI/IP Scenario 4: Multiple ONS DCC Areas

OSI/IP Scenario 4 (Figure 9-33) is similar to OSI/IP Scenario 3 except that the OSI GNE is subtended by multiple isolated ONS 15600 areas. A separate IP-over-CLNS tunnel is required to each isolated ONS 15600 OSPF area. An alternate approach is to create a single IP-over-CLNS tunnel from CTC/CTM to an ONS 15600 NE, and then to configure a tunnel from that NE to an NE in each isolated OSPF area. This approach requires additional static routes.

Figure 9-33 OSI/IP Scenario 4: Multiple ONS DCC Areas

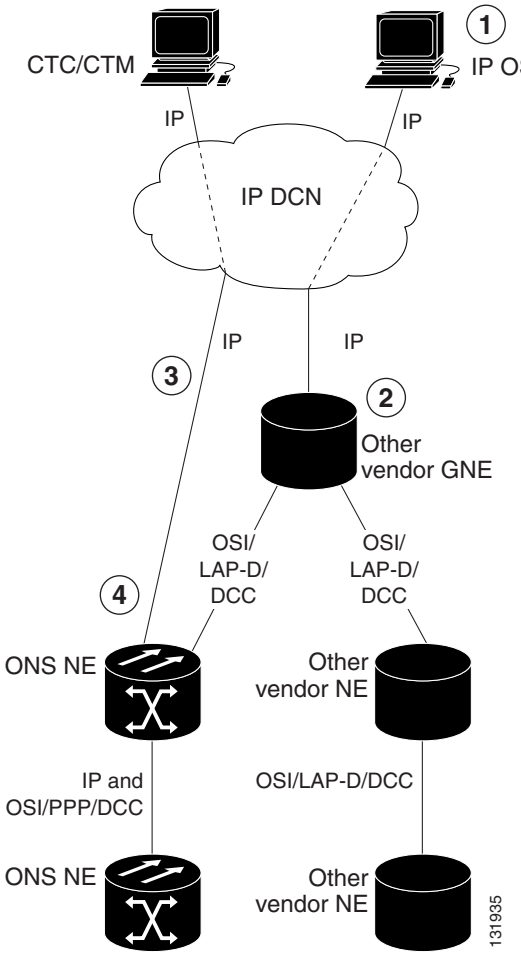


1	The IP OSS manages ONS 15600 and other vendor NEs using TL1 and FTP.
2	A separate tunnel is created for each isolated ONS 15600 DCC area.

9.7.9.5 OSI/IP Scenario 5: GNE Without an OSI DCC Connection

OSI/IP Scenario 5 (Figure 9-34) is similar to OSI/IP Scenario 3 except that the OSI GNE only has an IP connection to the DCN. It does not have an OSI DCN connection to carry CTC/CTM IP traffic through an IP-over-OSI tunnel. A separate DCN to ONS 15600 NE connection is created to provide CTC/CTM access.

Figure 9-34 OSI/IP Scenario 5: GNE Without an OSI DCC Connection

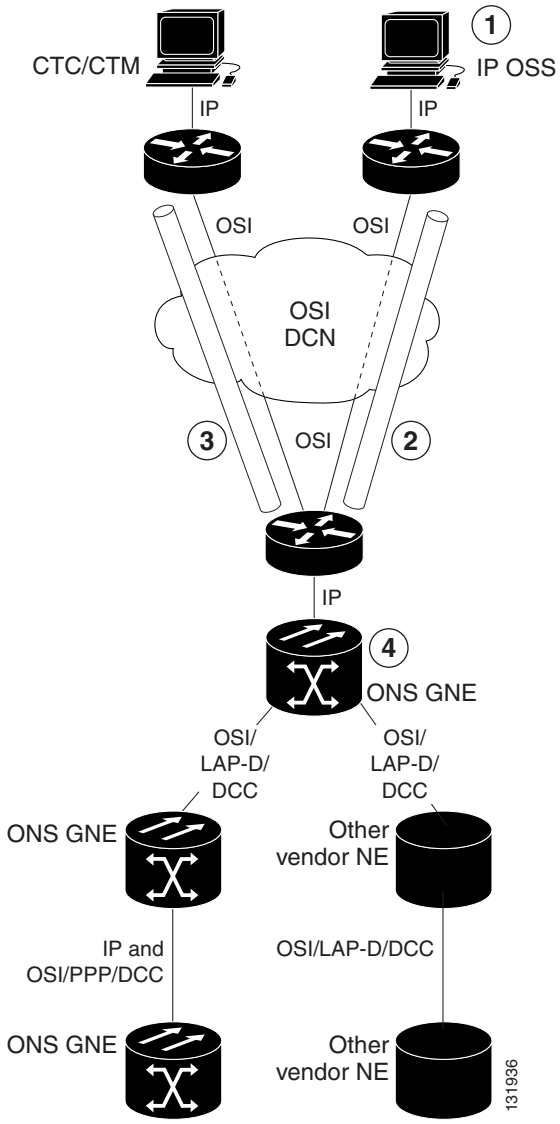


1	The IP OSS manages ONS 15600 and other vendor NEs using TL1 and FTP.
2	The other vendor GNE performs mediation on TL1 and FTP, so DCCs are OSI-only.
3	CTC/CTM communicates with ONS 15600 NEs over a separate IP DCN connection.
4	ONS 15600 NE exchanges TL1 over the full OSI stack. FTAM is used for file transfers.

9.7.9.6 OSI/IP Scenario 6: IP OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vendor ENE

OSI/IP Scenario 6 (Figure 9-35) shows how the ONS 15600 supports OSI DCNs. The OSI DCN has no impact on the ONS 15600 because all IP traffic (CTC/CTM, FTP, and TL1) is tunneled through the OSI DCN.

Figure 9-35 OSI/IP Scenario 6: IP OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vendor ENE

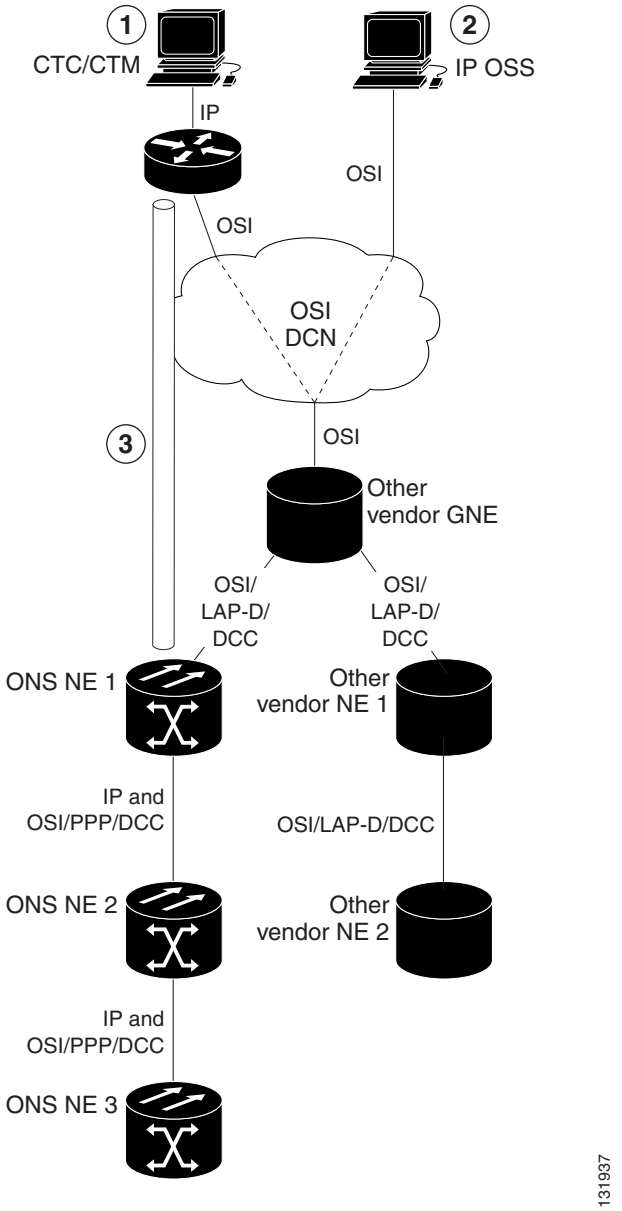


1	The IP OSS manages ONS 15600 and other vendor NEs using TL1 and FTP.
2	OSS IP traffic is tunneled through the DCN to the ONS 15600 GNE.
3	CTC/CTM IP traffic is tunneled through the DCN to the ONS 15600 GNE.
4	The GNE performs mediation for other vendor NEs.

9.7.9.7 OSI/IP Scenario 7: OSI OSS, OSI DCN, Other Vender GNE, OSI DCC, and ONS NEs

OSI/IP Scenario 7 (Figure 9-36) shows an example of a European network.

Figure 9-36 OSI/IP Scenario 7: OSI OSS, OSI DCN, Other Vender GNE, OSI DCC, and ONS NEs



1	ONS 15600 NEs are managed by CTC/CTM only (TL1/FTP is not used).
2	The OSI OSS manages other vendor NEs only.
3	CTC/CTM communicates with the ONS 15600 over a IP-over-CLNS tunnel between the ONS 15600 NE and external router.

In European networks:

- CTC and CTM are used for management only.
- IP-over-CLNS tunnels are widely accepted and deployed.

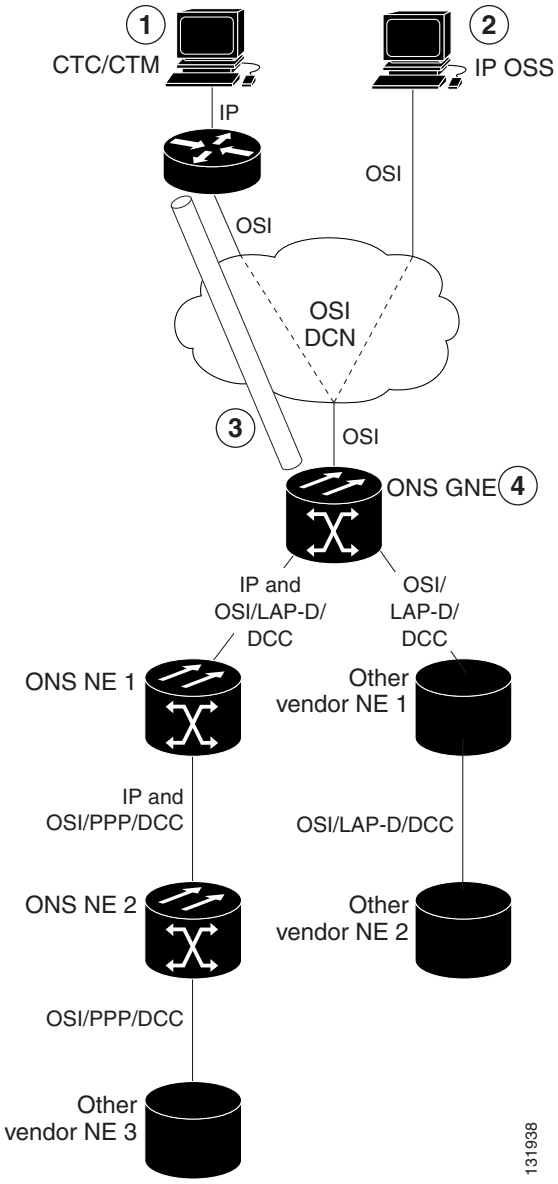
- TL1 management is not required.
- FTP file transfer is not required.
- TL1 and FTAM to FTP mediation is not required.

Management traffic between CTC/CTM and ONS 15600 NEs is carried over an IP-over-CLNS tunnel. A static route is configured on the ONS 15600 that terminates the tunnel (ONS 15600 NE 1) so that downstream ONS 15600 NEs (ONS 15600 NE 2 and 3) know how to reach CTC/CTM.

9.7.9.8 OSI/IP Scenario 8: OSI OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vender NEs

OSI/IP Scenario 8 (Figure 9-37) is another example of a European network. Similar to OSI/IP Scenario 7, the ONS 15600 NEs are solely managed by CTC/CTM. The CTC/CTM IP traffic is carried over a IP-over-OSI tunnel between an external router and the ONS 15600 GNE. The GNE extracts the IP from the tunnel and forwards it to the destination ONS 15600. Management traffic between the OSS and other vendor NEs is routed by the ONS 15600 GNE and NEs. This is possible because all ONS 15600 NEs run dual stacks (OSI and IP).

Figure 9-37 OSI/IP Scenario 8: OSI OSS, OSI DCN, ONS GNE, OSI DCC, and Other Vender NEs



1	The ONS NEs are managed by CTC/CTM only (TL1/FTP is not used).
2	The OSI OSS manages other vendor NEs only.
3	CTC/CTM communicates with the ONS 15600 over an IP-over-CLNS tunnel between the ONS 15600 NE and the external router. A static route is needed on the GNE.
4	The ONS 15600 GNE routes OSI traffic to other vendor NEs. No IP-over-CLNS tunnel is needed.

9.7.10 OSI Provisioning in CTC

Table 9-16 shows the OSI actions that are performed from the node view Provisioning tab. Refer to the *Cisco ONS 15600 Procedures Guide* for OSI procedures and tasks.

Table 9-16 OSI Actions from the CTC Provisioning Tab

Tab	Actions
OSI > Main Setup	• View and edit Primary Area Address. • Change OSI routing mode. • Change LSP buffers.
OSI > TARP > Config	Configure the TARP parameters: • PDU L1/L2 propagation and origination. • TARP data cache and loop detection buffer. • LAN storm suppression. • Type 4 PDU on startup. • TARP timers: LDB, T1, T2, T3, T4.
OSI > TARP > Static TDC	Add and delete static TARP data cache entries.
OSI > TARP > MAT	Add and delete static manual area table entries.
OSI > Routers > Setup	• Enable and disable routers. • Add, delete, and edit manual area addresses.
OSI > Routers > Subnets	Edit SDCC, LDCC, and LAN subnets that are provisioned for OSI.
OSI > Tunnels	Add, delete, and edit Cisco and IP-over-CLNS tunnels.
Comm Channels > SDCC	• Add OSI configuration to an SDCC. • Choose the data link layer protocol, PPP or LAP-D.
Comm Channels > LDCC	• Add OSI configuration to an SDCC.

Table 9-17 shows the OSI actions that are performed from the node view Maintenance tab.

Table 9-17 OSI Actions from the CTC Maintenance Tab

Tab	Actions
OSI > ISIS RIB	View the IS-IS routing table.
OSI > ESIS RIB	View ESs that are attached to ISs.
OSI > TDC	• View the TARP data cache and identify static and dynamic entries. • Perform TID to NSAP resolutions. • Flush the TDC.

CHAPTER 10

Ethernet Operation

This chapter describes the operation of the Cisco ONS 15600 ASAP Ethernet card.

For Ethernet card specifications, refer to Appendix A, "Hardware Specifications." For step-by-step Ethernet card circuit configuration procedures, refer to the *Cisco ONS 15600 Procedure Guide*. Refer to the *Cisco ONS SONET TL1 Command Guide* for TL1 provisioning commands.

Chapter topics include:

- 10.1 Any Service Any Port Card Application, page 10-1
- 10.2 Transport Functionality, page 10-2
- 10.3 Ethernet Rates and Mapping, page 10-4
- 10.4 Protocols over Ethernet, page 10-5
- 10.5 Buffering and Flow Control, page 10-6
- 10.6 Autonegotiation, page 10-7
- 10.7 Gigabit EtherChannel/IEEE 802.3ad Link Aggregation, page 10-8

10.1 Any Service Any Port Card Application

The Any Service Any Port (ASAP) Carrier Card plugs into any of the eight available I/O slots for the ONS 15600. Each ASAP carrier card has four slots available for up to and including four ASAP Pluggable Input/output Modules (PIMs). There are four slots available on the PIM for Pluggable Port Modules (PPM), which are Small Form-factor Pluggable (SFP) optics. Four PPMs per ASAP PIM are allowed, which means that there can be as many as 16 PPM optical network interfaces for each ASAP carrier card. Each PPM can support any of the following single-rate SFP optics:

- OC-3 LR-2
- OC-12 LR-2
- OC-48 LR-2

Each of the PPM ports also supports the following multirate SFP optics:

- OC-3-SR-1
- OC-12-SR-1
- OC-48 IR-1
- GE LX

Each ASAP 4-port I/O (ASAP_4PIO) PIM is hot-pluggable while other ports on other PIMs are functioning. Each SFP is also hot-pluggable.

Layer 1 Ethernet transport is implemented for Gigabit Ethernet (GE) interfaces. GE traffic is encapsulated by generic framing procedure (GFP), ITU X.86, or Cisco high-level data link control/LAN extension (HDLC/LEX) and mapped into a SONET payload.

The data path processing consists of:

- Optical-to-electrical conversion (O/E) and electrical to optical (E/O) on the ASAP_4PIO PIM
- Gigabit Ethernet to Ethernet over SONET (EoS) mapping (for the GE ports only)

Note For a single flow of Gigabit Ethernet, traffic can be mapped to an STS-48c. This choice limits maximum usable Ethernet ports to eight when all are mapped to STS-48c. Any time an STS-48c is used for an Ethernet connection, one-eighth of the total card bandwidth is consumed on the EoS mapper.

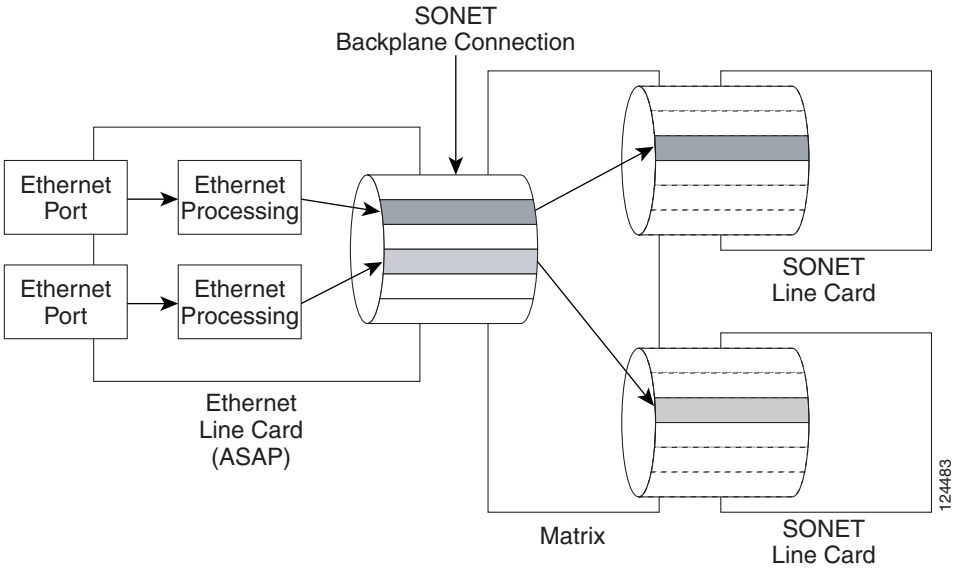
Ethernet facilities on the ASAP card include:

- Ethernet ports can be provisioned on a multirate PPM.
- Encapsulation methods allowed for the Ethernet ports are:
  - Cisco HDLC/LEX
  - GFP
  - ITU X.86
- Provisioning of an Ethernet port automatically provisions a POS port for the connection and circuit.

10.2 Transport Functionality

Figure 10-1 shows the transport of Ethernet frames into a SONET path using the ASAP carrier card in the ONS 15600.

Figure 10-1 ONS 15600 Ethernet Frame Transport

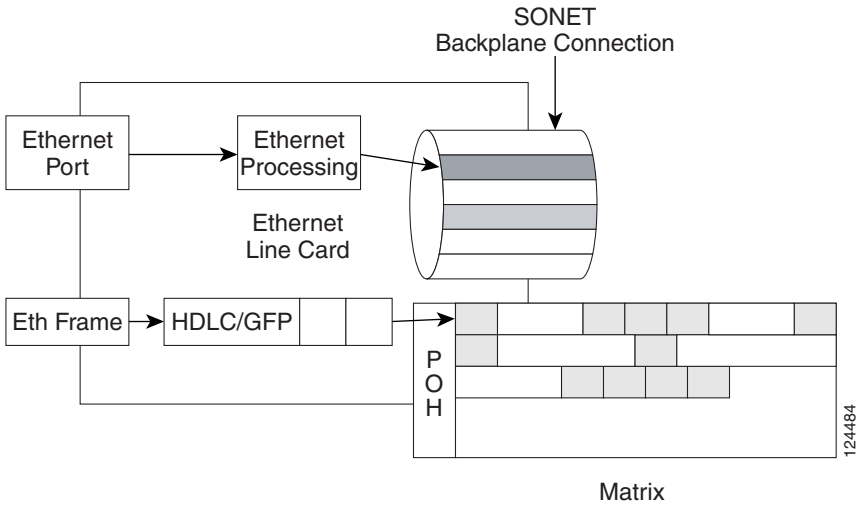


The ONS 15600 provides transport functionality of all frames arriving on the Ethernet interfaces. Frames arriving on each Ethernet interface are mapped onto their own SONET path. In the reverse direction, frames arriving on a SONET path are mapped to one and only one Ethernet interface. Frames arriving on different Ethernet interfaces are not mapped onto the same SONET path.

Valid received Ethernet frames are encapsulated and transported across the SONET network. There are no modifications made to any bits in the frame that is delivered at the destination Ethernet port. Because invalid frames are dropped, this transport is not transparent.

Figure 10-2 shows Ethernet framing with HDLC/GFP header/trailers and mapping into a synchronous payload envelope (SPE) for transport over a SONET network.

Figure 10-2 Ethernet Framing



A valid frame is defined as one with the following attributes:

- Valid preamble + synchronization
- Valid size
- Valid cyclic redundancy check (CRC)
- Valid interpacket gap

10.3 Ethernet Rates and Mapping

This section explains the Ethernet frame format, encapsulation methods, path and circuit configurations, and oversubscription.

10.3.1 Frame Size

The IEEE 802.3 frame format is supported on the GE interfaces. The minimum frame size supported by the system is 64 bytes; the interface drops smaller sized frames. The maximum frame size per interface is 9600 bytes and can be provisioned independently. 9600 bytes is the maximum transmission unit (MTU).

10.3.2 Encapsulations

The Ethernet ports can be provisioned for encapsulation in frame-mapped GFP (GFP-F) as per ITU G.7041, Cisco HDLC/LEX as per RFC 1841, or Ethernet over Link Access Protocol over SDH (LAPS) as per ITU X.86. LEX with CRC-32 is the default encapsulation, as it is supported by most Cisco data cards.

The value of the C2 byte in a high-order SONET path is set to the following values for each encapsulation type:

- 0x1B for GFP-F
- 0x18 for X.86
- 0x05 for LEX with CRC-16
- 0x01 for LEX with CRC-32

Note Bridge Control Protocol (BCP), HDLC, LEX, and ITU X.86 are all variations of Point-to-Point Protocol (PPP) in HDLC framing. To the Ethernet processor, the packets look essentially the same. GFP encapsulation is drastically different.

10.3.3 Path and Circuit Sizes

GE interfaces can be mapped to all supported SONET paths of sizes STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, and STS-48c.

Note Mapping depends on the particular concatenation being supported on the card. It also depends on the concatenation being supported on all of the network elements (NEs) that the end-to-end circuit is being built through.

For full line-rate mapping to ensure that no frames are dropped, a GE interface is mapped to either an STS-24c or an STS-48c. At the STS-24c rate, the effects of bandwidth expansion due to HDLC/GFP/ITU X.86 encapsulations need to be taken into account to ensure no packet loss.

10.3.4 Oversubscription

Oversubscription of data interfaces is the mapping of an interface to a path with a lower bandwidth than the rate of the interface. When oversubscribing, the operator is relying on the fact that on data interfaces, packet transmission rates and utilization is not always 100 percent. For example, a customer with a GE interface might transmit at an average rate of only 100 Mbps.

To ensure that packet loss does not occur or that any ensuing packet loss is minimized, system engineers need to carefully estimate the amount of memory in the NE that is required to sustain any traffic bursts. Traffic bursts are characterized by several different models that take into account such parameters as the mean rate, peak rates, length of burst, and so on. Performing these calculations is more important in switching applications than in transport applications.

In the ONS 15600, oversubscription of interfaces is supported. This occurs when the GE interface is mapped to any of the STS-1, STS-3, STS-6, STS-9, and STS-12 (c) rates. No guarantees on frame loss or delay due to oversubscription is provided by the system. Actual loss and delay values depend on incoming Ethernet traffic patterns.

10.4 Protocols over Ethernet

The ASAP card supports the BCP, PPP Half Bridge, and VLAN protocols, described in the following subsections.

10.4.1 Bridge Control Protocol

Support of BCP is relevant between two routers or bridges. An Ethernet card providing transport functionality is neither a router nor a bridge. Therefore, even BCP encapsulation is not supported on the Ethernet ports of the ASAP transport line card.

The ASAP line card Ethernet function is transparent to any Layer 2 and above protocol packets (the entire control plane). Any BCP control packets are transported out to the SONET interface.

10.4.2 PPP Half Bridge

For situations in which a routed network needs connectivity to a remote bridged Ethernet network, a serial or integrated services digital network (ISDN) interface can be configured to function as a PPP half-bridge. The line to the remote bridge functions as a virtual Ethernet interface, and the router's serial or ISDN interface functions as a node on the same Ethernet subnetwork as the remote network.

The bridge sends bridge packets to the PPP half-bridge, which converts them to routed packets and forwards them to other router processes. Likewise, the PPP half-bridge converts routed packets to Ethernet bridge packets and sends them to the bridge on the same Ethernet subnetwork.

The ASAP line card is transparent to any Layer 2 and above protocol packets (the entire control plane). Any PPP Half Bridge control packets are transported out to the SONET interface.

10.4.3 VLAN

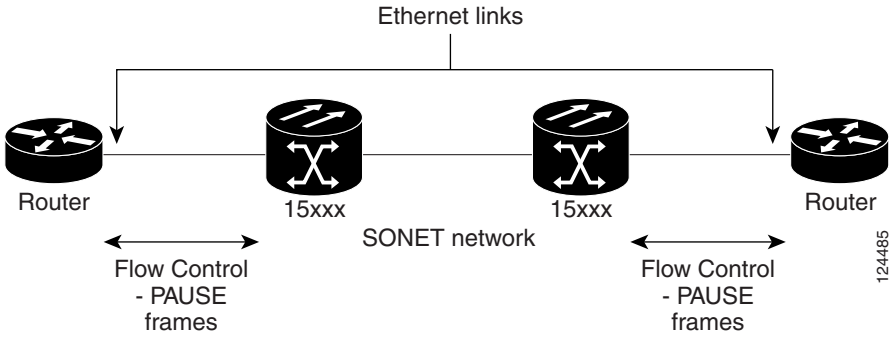
The ASAP line card is transparent to VLAN tag information in the Ethernet frame.

Note VLANs are tunneled, and not terminated.

10.5 Buffering and Flow Control

Because the STS circuits can often be oversubscribed (have a bandwidth lower than that needed to support the traffic on the Ethernet port), a combination of buffering and local flow control is supported. Initially, frames that arrive on an ingress interface that cannot be transmitted immediately on the egress interface are placed in an ingress buffer. When this buffer starts filling up and is in danger of overflowing, flow control is employed. Local flow control is flow control between the Ethernet interface and the router or switch it is connected to, over the single Ethernet link. This is depicted in Figure 10-3.

Figure 10-3 Buffering and Flow Control



To prevent dropping of frames on an ingress Ethernet interface due to buffer congestion, an Ethernet interface sends a PAUSE frame to its peer on its egress Ethernet interface. An Ethernet interface might be capable of both sending and receiving PAUSE frames (symmetric flow control). On the other hand, it might be capable of performing only one of the two (asymmetric flow control). Two factors determine what an Ethernet interface ultimately ends up supporting:

- Flow control capability of the interface as provisioned by the operator (fixed at OFF or ON)
- Flow control capability of the peer as determined by AutoNegotiation

The Ethernet interfaces are capable of using symmetric or asymmetric flow control to meter packet receptions according to the requirements specified in IEEE 802.3x. This is done to avoid dropping packets internally due to output or input queue congestion. When an Ethernet interface uses symmetric

flow control, it generates and obeys pause frames. When it uses asymmetric flow control, it only generates pause frames. Through management control, the Ethernet interface allows an operator to turn flow control ON or OFF (the default is ON).

When an Ethernet interface is set to be capable of generating PAUSE frames, it starts generating them at a rate of X PAUSE frames per second when the ingress buffer passes above a certain level called the High Water Mark. A PAUSE_TIME is specified in each PAUSE frame. The values of the PAUSE_TIME parameter and the rate X parameter are determined by the system and are not user settable.

It is expected that the peer Ethernet interface stops sending new frames after receiving a PAUSE frame for the amount of time as specified in the PAUSE_TIME. When an Ethernet interface is actively generating PAUSE frames, it stops generating them when the ingress buffer passes below a certain level, called the Low Water Mark. It is expected that the peer Ethernet interface starts sending new frames after the PAUSE frames stop.

When an Ethernet interface is set to be capable of receiving PAUSE frames, it temporarily suspends transmission of any new Ethernet frames upon reception of a PAUSE frame from its peer. Note that the transmission of any Ethernet frames already begun are completed.

When an Ethernet interface has temporarily PAUSED transmission of Ethernet frames, it resumes transmission of the frames when no new PAUSE frame is received within the PAUSE_TIME specified in the last received PAUSE frame.

The High Water Mark and Low Water Mark values are both operator provisionable. Legal values are as follows:

- Low Water Mark: from 10 kB to 74 kB
- High Water Mark: from 11 kB to 75 kB

The Low Water Mark is always lower than the High Water Mark.

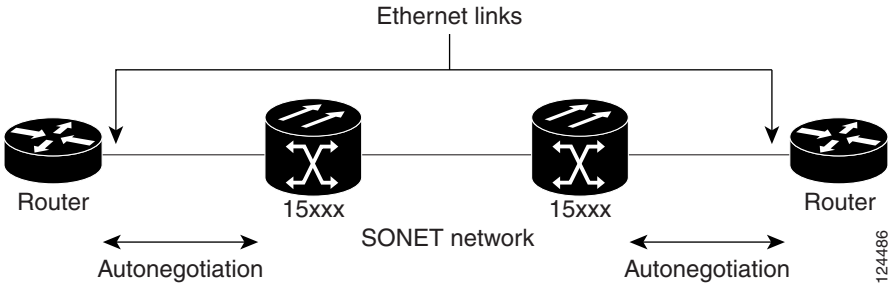
The ASAP line card utilizes tail drop when frames need to be dropped. This means that the last frames received are the first to be dropped. This is implemented with a Last In First Out (LIFO) buffer.

10.6 Autonegotiation

The Ethernet interfaces on the ASAP card are capable of autonegotiating for full duplex (only) operation as per IEEE 802.3z. The default provisioning is to autonegotiate the duplex mode and persists in memory. Autonegotiation can be provisioned to be ON or OFF.

When flow control is turned on (and so is autonegotiation), the Ethernet interface autonegotiates and advertises all modes that it supports. The mode used by the Ethernet interface is the one agreed to by the Ethernet peers. If an agreement on the supported flow control mode cannot be reached, the transmitter is turned off. Autonegotiation is depicted in Figure 10-4.

Figure 10-4 Autonegotiation

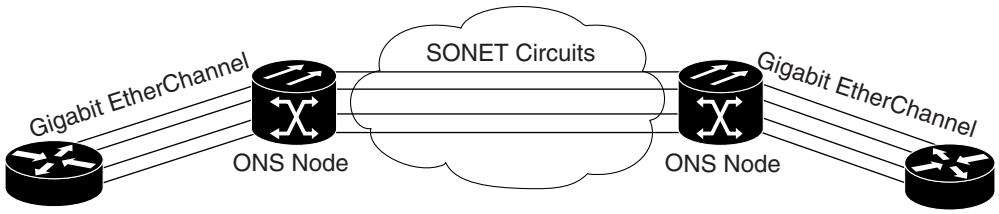


10.7 Gigabit EtherChannel/IEEE 802.3ad Link Aggregation

The end-to-end Ethernet link integrity feature can be used in combination with Gigabit EtherChannel (GEC) capability on attached devices. The combination provides an Ethernet traffic restoration scheme that has a faster response time than alternate techniques such as spanning tree rerouting, yet is more bandwidth efficient because spare bandwidth does not need to be reserved.

The ASAP card supports all forms of link aggregation technologies including GEC, which is a Cisco proprietary standard, and the IEEE 802.3ad standard. The end-to-end link integrity feature ASAP card allows a circuit to emulate an Ethernet link. This allows all flavors of Layer 2 and Layer 3 rerouting to work correctly with the ASAP card. Figure 10-5 illustrates GEC support.

Figure 10-5 ASAP Gigabit EtherChannel (GEC) Support



Although the ASAP card does not actively run GEC, it supports the end-to-end GEC functionality of attached Ethernet devices. If two Ethernet devices running GEC connect through the ASAP card to an ONS network, the ONS SONET side network is transparent to the EtherChannel devices. The EtherChannel devices operate as if they are directly connected to each other. Any combination of parallel circuit sizes can be used to support GEC throughput.

GEC provides line-level active redundancy and protection (1:1) for attached Ethernet equipment. It can also bundle parallel data links together to provide more aggregated bandwidth. Spanning Tree Protocol (STP) operates as if the bundled links are one link and permits GEC to utilize these multiple parallel paths. Without GEC, STP permits only a single nonblocked path. GEC can also provide ASAP card-level protection or redundancy because it can support a group of ports on different cards (or different nodes) so that if one port or card has a failure, traffic is rerouted over the other port or card.

Alarm Monitoring and Management

This chapter explains how to manage alarms with Cisco Transport Controller (CTC), which includes:

- 11.1 Overview, page 11-1
- 11.2 Alarms, Conditions, and History, page 11-1
- 11.3 Alarm Profiles, page 11-9
- 11.4 Alarm Filter, page 11-12
- 11.5 Alarm Suppression, page 11-12
- 11.6 External Alarms and Controls, page 11-13

To troubleshoot specific alarms, refer to the *Cisco ONS 15600 Troubleshooting Guide*.

11.1 Overview

CTC detects and reports SONET alarms generated by the Cisco ONS 15600 and the larger SONET network. You can use CTC to monitor and manage alarms at the card, node, or network level. Default alarm severities conform to the Telcordia GR-474-CORE standard, but you can set alarm severities in customized alarm profiles or suppress CTC alarm reporting. For a detailed description of the standard Telcordia categories employed by Optical Networking System (ONS) nodes, refer to the *Cisco ONS 15600 Troubleshooting Guide* "Alarm Troubleshooting" chapter.

Note ONS 15600 alarms can also be monitored and managed through TL1 or a network management system (NMS).

11.2 Alarms, Conditions, and History

In the card, node, or network level CTC view, click the Alarms tab to display the alarms for that card, node or network. The Alarms window shows alarms in conformance to Telcordia GR-253-CORE. This means that if a network problem causes two alarms, such as loss of frame (LOF) and loss of signal (LOS), CTC only shows the LOS alarm in this window because it supersedes LOF. (The LOF alarm can still be retrieved in the Conditions window.)

Table 11-1 describes in the information in the Alarms window.

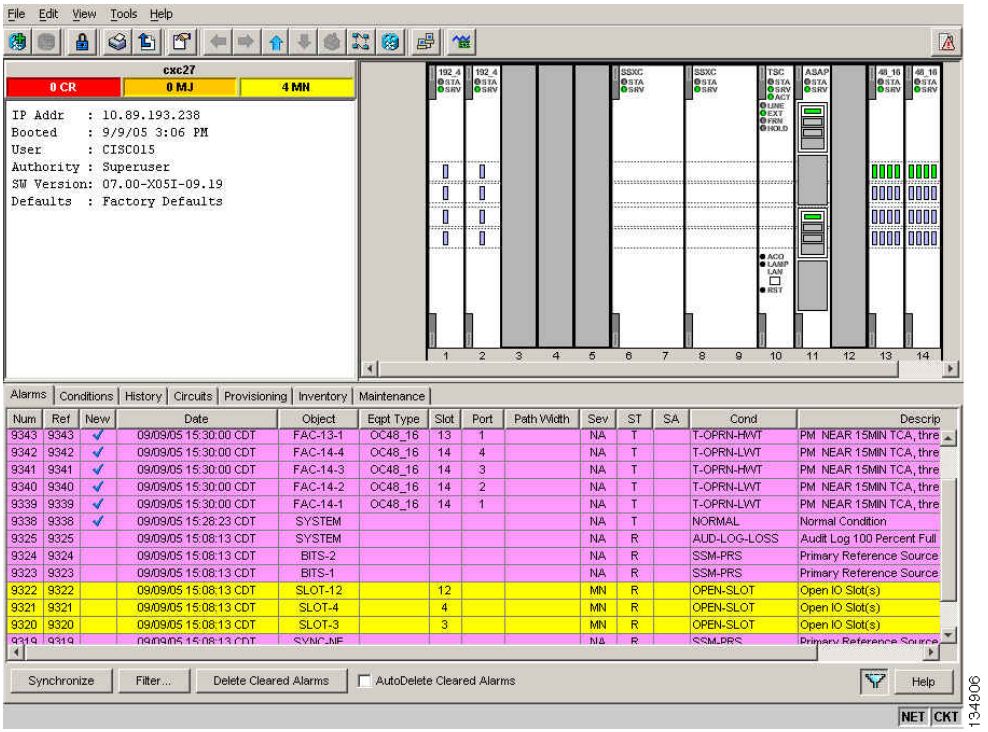
Table 11-1 Alarms Column Descriptions

Column	Information Recorded
Num	Quantity of alarm messages received; incremented automatically as alarms occur to display the current total of received error messages
Ref	A unique identification number assigned to each alarm to reference a specific alarm message that is displayed
New	Indicates a new alarm if checked[1]
Date	Date and time of the alarm
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.)
Object	TL1 access identifier (AID) for the alarmed object
Eqpt Type	Card type in this slot
Shelf	The shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the alarm occurred (appears in the network view and node view)
Port	Port where the alarm occurred
Path Width	Indicates how many STSs are contained in the alarmed path. This information complements the alarm object notation, which is explained in the "Alarm Troubleshooting" chapter of the *Cisco ONS 15600 Troubleshooting Guide*.
Sev	Severity level: Critical (CR), Major (MJ), Minor (MN), Not Alarmed (NA), Not Reported (NR)
ST	Status: Raised (R), Clear (C), Transient (T)
SA	When checked, indicates a service-affecting alarm
Cond	Error message/alarm name; alphabetically defined in the *Cisco ONS 15600 Troubleshooting Guide*
Description	Description of the alarm

1. The user can click the Synchronize button to acknowledge the new alarm. Clicking the Delete Cleared Alarms button only deletes cleared alarms on the window.

Figure 11-1 shows the CTC node view Alarms window.

Figure 11-1 Viewing Alarms in CTC Node View


File Edit View Tools Help
csc27
0 CR
0 MJ
4 MN
IP Addr : 10.89.193.238
Booted : 9/9/05 3:06 PM
User : CISCO15
Authority : Superuser
SW Version: 07.00-X05I-09.19
Defaults : Factory Defaults
Alarms Conditions History Circuits Provisioning Inventory Maintenance
Num Ref New Date Object Eqpt Type Slot Port Path Width Sev ST SA Cond Descrip
9343 9343 09/09/05 15:30:00 CDT FAC-13-1 OC48_16 13 1 NA T T-OPRN-HWT PM NEAR 15MIN TCA, thre
9342 9342 09/09/05 15:30:00 CDT FAC-14-4 OC48_16 14 4 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9341 9341 09/09/05 15:30:00 CDT FAC-14-3 OC48_16 14 3 NA T T-OPRN-HWT PM NEAR 15MIN TCA, thre
9340 9340 09/09/05 15:30:00 CDT FAC-14-2 OC48_16 14 2 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9339 9339 09/09/05 15:30:00 CDT FAC-14-1 OC48_16 14 1 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9338 9338 09/09/05 15:28:23 CDT SYSTEM NA T NORMAL Normal Condition
9325 9325 09/09/05 15:08:13 CDT SYSTEM NA R AUD-LOG-LOSS Audit Log 100 Percent Full
9324 9324 09/09/05 15:08:13 CDT BITS-2 NA R SSM-PRS Primary Reference Source
9323 9323 09/09/05 15:08:13 CDT BITS-1 NA R SSM-PRS Primary Reference Source
9322 9322 09/09/05 15:08:13 CDT SLOT-12 12 MN R OPEN-SLOT Open IO Slot(s)
9321 9321 09/09/05 15:08:13 CDT SLOT-4 4 MN R OPEN-SLOT Open IO Slot(s)
9320 9320 09/09/05 15:08:13 CDT SLOT-3 3 MN R OPEN-SLOT Open IO Slot(s)
Synchronize
Filter...
Delete Cleared Alarms
AutoDelete Cleared Alarms
Help
NET CKT
134906

Alarms and conditions appear in one of five background colors, listed in Table 11-2, to communicate severity.

Table 11-2 Color Codes for Alarms and Conditions

Color	Description
Red	Critical alarm
Orange	Major alarm
Yellow	Minor alarm
Magenta (pink)	Event (NA)
Blue	Condition (NR)
White	Cleared alarm or event (C)

Note Major and Minor alarms may appear yellow in CTC under certain circumstances. This is not due to a CTC problem but to a workstation memory and color utilization problem. For example, a workstation might run out of colors if many color-intensive applications are running. When using Netscape, you can limit the number of colors used by launching it from the command line with either the -install option or the -ncols 32 option.

Software Releases 7.0 and later have TL1 port-based alarm numbering that identifies an alarmed synchronous transport signal (STS) by its STS on a port rather than the STS on the optical card. The numbering is present in the STS alarm TL1 AID. The numbering scheme is described in Table 11-3.

Table 11-3 TL1 Port-Based Alarm Numbering Scheme

MON Object (Optical)	Syntax and Examples
OC3/12/48/192 STS	Syntax: STS-<Slot>-<Pim>-<Ppm>-<Port>-<STS> Ranges: STS-{1-4,11-14}-{1-4}-{1-4}-{1-n^1}-{1-n^2} Example: STS-1-1-1-1-6

1. Port number range varies by card type with a maximum of four.
2. Maximum STS number depends on the rate and size of the STS.

11.2.1 Alarm Window

Table 11-4 shows the actions you can perform in the Alarms window.

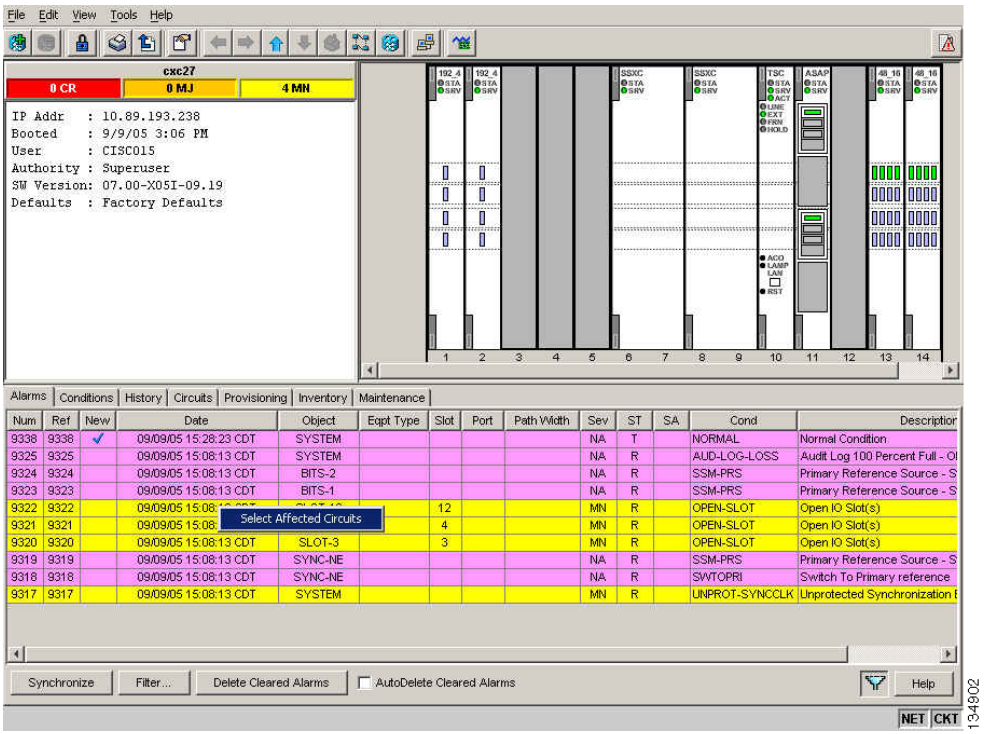
Table 11-4 Alarm Window

Button	Action
Filter	Allows you to change the display on the Alarms window to show only alarms that meet a certain severity level, occur in a specified time frame, and/or reflect specific conditions. For example, you can set the filter so that only Critical alarms appear on the window. If you enable the Filter feature by clicking the Filter icon button in one CTC view, such as node view, it is enabled in the others as well (card view and network view).
Synchronize	Updates the alarm display. Although CTC displays alarms in real time, the Synchronize button verifies that CTC and the ONS 15600 agree on current alarms. This is particularly useful during provisioning or troubleshooting.
Delete Cleared Alarms	Deletes alarms that have been cleared.
AutoDelete Cleared Alarms	If checked, CTC automatically deletes cleared alarms.

11.2.2 Alarm-Affected Circuits

You can determine which ONS 15600 circuits are affected by a specific alarm by positioning the cursor over the alarm in the Alarm window and right-clicking. A shortcut menu appears (Figure 11-2).

Figure 11-2 Select the Affected Circuits Option for an Alarm


File Edit View Tools Help
cxc27
0 CR
0 MJ
4 MN
IP Addr : 10.89.193.238
Booted : 9/9/05 3:06 PM
User : CISCO15
Authority : Superuser
SW Version: 07.00-X05I-09.19
Defaults : Factory Defaults
Alarms Conditions History Circuits Provisioning Inventory Maintenance
Num Ref New Date Object Eqpt Type Slot Port Path Width Sev ST SA Cond Description
9338 9338 09/09/05 15:28:23 CDT SYSTEM NA T NORMAL Normal Condition
9325 9325 09/09/05 15:08:13 CDT SYSTEM NA R AUD-LOG-LOSS Audit Log 100 Percent Full - O
9324 9324 09/09/05 15:08:13 CDT BITS-2 NA R SSM-PRS Primary Reference Source - S
9323 9323 09/09/05 15:08:13 CDT BITS-1 NA R SSM-PRS Primary Reference Source - S
9322 9322 12 MN R OPEN-SLOT Open IO Slot(s)
9321 9321 4 MN R OPEN-SLOT Open IO Slot(s)
9320 9320 09/09/05 15:08:13 CDT SLOT-3 3 MN R OPEN-SLOT Open IO Slot(s)
9319 9319 09/09/05 15:08:13 CDT SYNC-NE NA R SSM-PRS Primary Reference Source - S
9318 9318 09/09/05 15:08:13 CDT SYNC-NE NA R SWTOPRI Switch To Primary reference
9317 9317 09/09/05 15:08:13 CDT SYSTEM MN R UNPROT-SYNCCLK Unprotected Synchronization
Select Affected Circuits
Synchronize
Filter...
Delete Cleared Alarms
AutoDelete Cleared Alarms
Help
NET CKT
134902

When the user selects the Select Affected Circuits option, the Circuits window opens to show the circuits that are affected by the alarm.

11.2.3 Conditions Window

The Conditions window displays retrieved fault conditions. A condition is a fault or status detected by ONS 15600 hardware or software. When a condition occurs and continues for a minimum period, CTC raises a condition, which is a flag showing that this particular condition currently exists on the ONS 15600.

The Conditions window shows all conditions that occur, including those that are superseded by alarms. For instance, if a network problem causes two alarms, such as LOF and LOS, CTC shows both the LOF and LOS conditions in this window. Having all conditions visible can be helpful when troubleshooting the ONS 15600. If you want to retrieve conditions that obey a root-cause hierarchy (that is, LOS supersedes and replaces LOF), you can exclude the same root causes.

Fault conditions include reported alarms and Not Reported or Not Alarmed conditions. Refer to the trouble notifications information in the *Cisco ONS 15600 Troubleshooting Guide* "Alarm Troubleshooting" chapter for more information about alarm and condition classifications.

11.2.4 Conditions Window Actions

Table 11-5 shows the actions you can perform in the Conditions window.

Table 11-5 Conditions Display

Button	Action
Retrieve	Retrieves the current set of all existing fault conditions, as maintained by the alarm manager, from the ONS 15600.
Filter	Allows you to change the Conditions window display to only show the conditions that meet a certain severity level or occur in a specified time. For example, you can set the filter so that only Critical conditions display on the window. There is a Filter icon button in the lower-right corner of the window that allows you to enable or disable the filter feature.

The current set of all existing conditions maintained by the alarm manager appears when you click the Retrieve button. The set of conditions retrieved is relative to the view. For example, if you click the button in the node view, node-specific conditions appear (Figure 11-3). If you click the Retrieve button in the network view, all conditions for the network (including ONS 15600 nodes and other connected nodes such as ONS 15454s) appear, and the card view shows only card-specific conditions.

Figure 11-3 Viewing Conditions in the Conditions Window

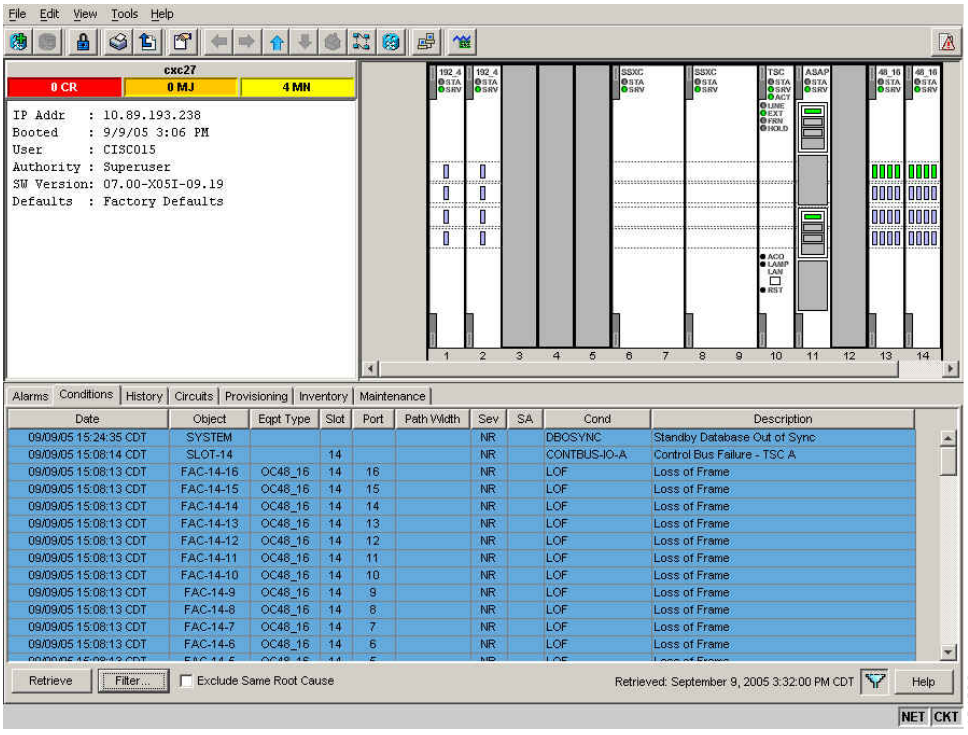

File Edit View Tools Help
exc27
0 CR
0 MJ
4 MN
IP Addr : 10.89.193.238
Booted : 9/9/05 3:06 PM
User : CISCO15
Authority : Superuser
SW Version: 07.00-X05I-09.19
Defaults : Factory Defaults
Alarms Conditions History Circuits Provisioning Inventory Maintenance
Date Object Eqpt Type Slot Port Path Width Sev SA Cond Description
09/09/05 15:24:35 CDT SYSTEM NR DBOSYNC Standby Database Out of Sync
09/09/05 15:08:14 CDT SLOT-14 14 NR CONTBUS-IO-A Control Bus Failure - TSC A
09/09/05 15:08:13 CDT FAC-14-16 OC48_16 14 16 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-15 OC48_16 14 15 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-14 OC48_16 14 14 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-13 OC48_16 14 13 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-12 OC48_16 14 12 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-11 OC48_16 14 11 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-10 OC48_16 14 10 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-9 OC48_16 14 9 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-8 OC48_16 14 8 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-7 OC48_16 14 7 NR LOF Loss of Frame
09/09/05 15:08:13 CDT FAC-14-6 OC48_16 14 6 NR LOF Loss of Frame
Retrieve
Filter...
Exclude Same Root Cause
Retrieved: September 9, 2005 3:32:00 PM CDT
Help
NET CKT
134892

Table 11-6 lists the Conditions window column headings and the information recorded in each column.

Table 11-6 Conditions Column Description

Column	Information Recorded
Date	Date and time of the condition
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.)
Object	TL1 AID for the alarmed object
Eqpt Type	Card type in this slot (only displayed in the network view and node view)
Shelf	The shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the condition occurred (only displayed in the network view and node view)
Port	Port where the condition occurred
Path Width	Width of the data path
Sev	Severity level: CR, MJ, MN, NA, NR
SA	When checked, indicates a service-affecting alarm
Cond	Condition name; alphabetically listed and defined in the "Alarm Troubleshooting" chapter of the *Cisco ONS 15600 Troubleshooting Guide*
Description	Description of the condition

11.2.5 History Window

The History window displays historical alarm data. It also displays conditions, which are Not Alarmed activities such as timing changes and threshold crossings. For example, protection-switching events or performance-monitoring threshold crossings appear here. The ONS 15600 can store up to 3,000 total alarms and conditions: 750 Critical alarms, 750 Major alarms, 750 Minor alarms, and 750 conditions. When the limit is reached, the ONS 15600 begins replacing the oldest items. The History window presents several alarm history views:

- The History > Session window appears in network view, node view, and card view (Figure 11-4). It shows alarms and conditions that have occurred during the current user CTC session.
- The History > Shelf window appears only in node view. It shows the alarms and conditions that have occurred on the node since CTC software was originally activated for that node.
- The History > Card window appears only in the card view. It shows the alarms and conditions that have occurred on the card since CTC software was installed on the node.

Note In the Preference dialog box General tab, the Maximum History Entries value applies to only the Session window.

Tip Double-click an alarm in the History window to display the corresponding view. For example, double-clicking a card alarm takes you to card view. In network view, double-clicking a node alarm takes you to node view.

Figure 11-4 Viewing All Alarms Reported for a Node

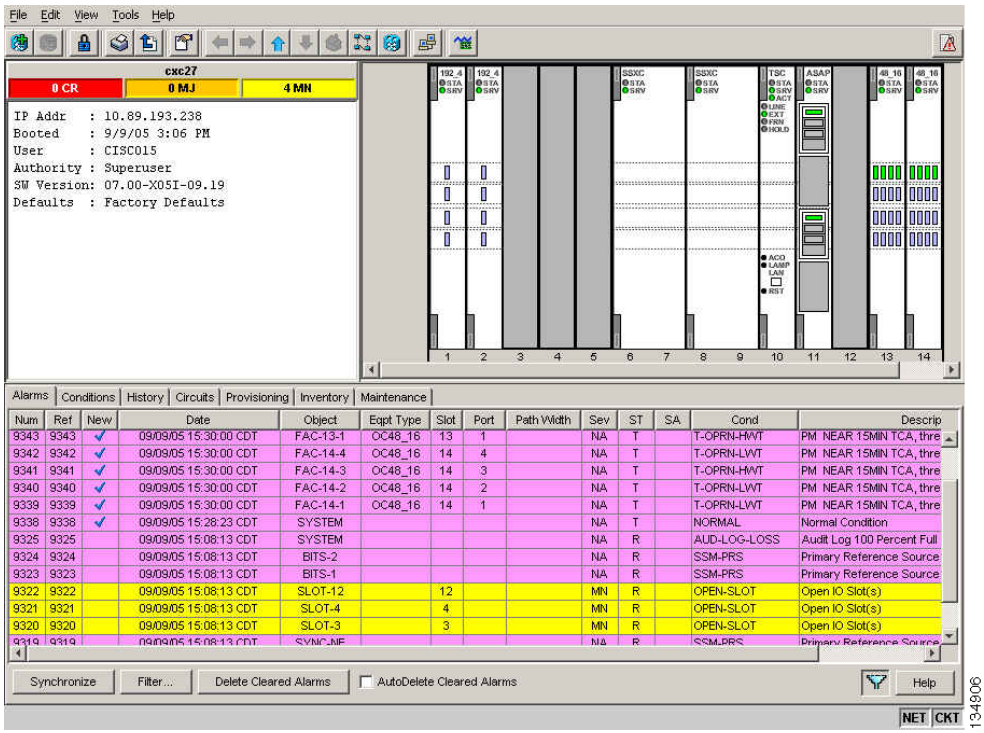

File Edit View Tools Help
cxc27
0 CR
0 MJ
4 MN
IP Addr : 10.89.193.238
Booted : 9/9/05 3:06 PM
User : CISCO15
Authority : Superuser
SW Version: 07.00-X05I-09.19
Defaults : Factory Defaults
Alarms Conditions History Circuits Provisioning Inventory Maintenance
Num Ref New Date Object Eqpt Type Slot Port Path Width Sev ST SA Cond Descrip
9343 9343 09/09/05 15:30:00 CDT FAC-13-1 OC48_16 13 1 NA T T-OPRN-HWT PM NEAR 15MIN TCA, thre
9342 9342 09/09/05 15:30:00 CDT FAC-14-4 OC48_16 14 4 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9341 9341 09/09/05 15:30:00 CDT FAC-14-3 OC48_16 14 3 NA T T-OPRN-HWT PM NEAR 15MIN TCA, thre
9340 9340 09/09/05 15:30:00 CDT FAC-14-2 OC48_16 14 2 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9339 9339 09/09/05 15:30:00 CDT FAC-14-1 OC48_16 14 1 NA T T-OPRN-LWT PM NEAR 15MIN TCA, thre
9338 9338 09/09/05 15:26:23 CDT SYSTEM NA T NORMAL Normal Condition
9325 9325 09/09/05 15:08:13 CDT SYSTEM NA R AUD-LOG-LOSS Audit Log 100 Percent Full
9324 9324 09/09/05 15:08:13 CDT BITS-2 NA R SSM-PRS Primary Reference Source
9323 9323 09/09/05 15:08:13 CDT BITS-1 NA R SSM-PRS Primary Reference Source
9322 9322 09/09/05 15:08:13 CDT SLOT-12 12 MN R OPEN-SLOT Open IO Slot(s)
9321 9321 09/09/05 15:08:13 CDT SLOT-4 4 MN R OPEN-SLOT Open IO Slot(s)
9320 9320 09/09/05 15:08:13 CDT SLOT-3 3 MN R OPEN-SLOT Open IO Slot(s)
Synchronize
Filter...
Delete Cleared Alarms
AutoDelete Cleared Alarms
Help
NET CKT
134906

Table 11-7 describes the information in the History window.

Table 11-7 History Column Description

Column	Information Recorded
Num	An incrementing count of alarm or condition messages. (The column is hidden by default; to view it, right-click a column and choose **Show Column > Num**.)
Ref	The reference number assigned to the alarm or condition. (The column is hidden by default; to view it, right-click a column and choose **Show Column > Ref**.)
Date	Date and time of the alarm
Node	Shows the name of the node where the condition or alarm occurred. (Visible in network view.)
Object	TL1 AID for the alarmed object
Eqpt Type	Card type in this slot (only displays in network view and node view)
Shelf	The shelf where the alarmed object is located. Visible in network view.
Slot	Slot where the condition occurred (only displays in network view and node view)
Port	Port where the condition occurred
Path Width	Width of the data path
Sev	Severity level: CR, MJ, MN, NA, NR
SA	When checked, indicates a service-affecting alarm
ST	Status: R (raised), C (cleared), T (transient)

Table 11-7 History Column Description (continued)

Column	Information Recorded
Description	Description of the condition
Cond	Condition name

11.2.6 Alarm History Actions

You can retrieve and view the history of alarms and conditions, as well as Transient conditions (passing notifications of processes as they occur) in the CTC History window. The information in this window is specific to the view where it is shown (that is, network history in the network view, node history in the node view, and card history in the card view). For more information about Transient conditions, refer to the "Transient Conditions" chapter in the *Cisco ONS 15600 Troubleshooting Guide*.

The node and card history views are each divided into two tabs. In node view, when you click the Retrieve button, you can see the history of alarms, conditions, and transients that have occurred on the node in the History > Shelf window, and the history of alarms, conditions, and transients that have occurred on the node during your login session in the History > Session window. When you retrieve the card history, you can see the history of alarms, conditions, and transients on the card in the History > Card window, or a history of alarms, conditions, and transients that have occurred during your login session in the History > Session window. You can also filter the severities and occurrence period in these history windows.

11.3 Alarm Profiles

The alarm profiles feature allows you to change default alarm severities by creating unique alarm profiles for individual ONS 15600 ports, cards, or nodes. A created alarm profile can be applied to any node on the network. Alarm profiles can be saved to a file and imported elsewhere in the network, but the profile must be stored locally on a node before it can be applied to the node, cards, or ports.

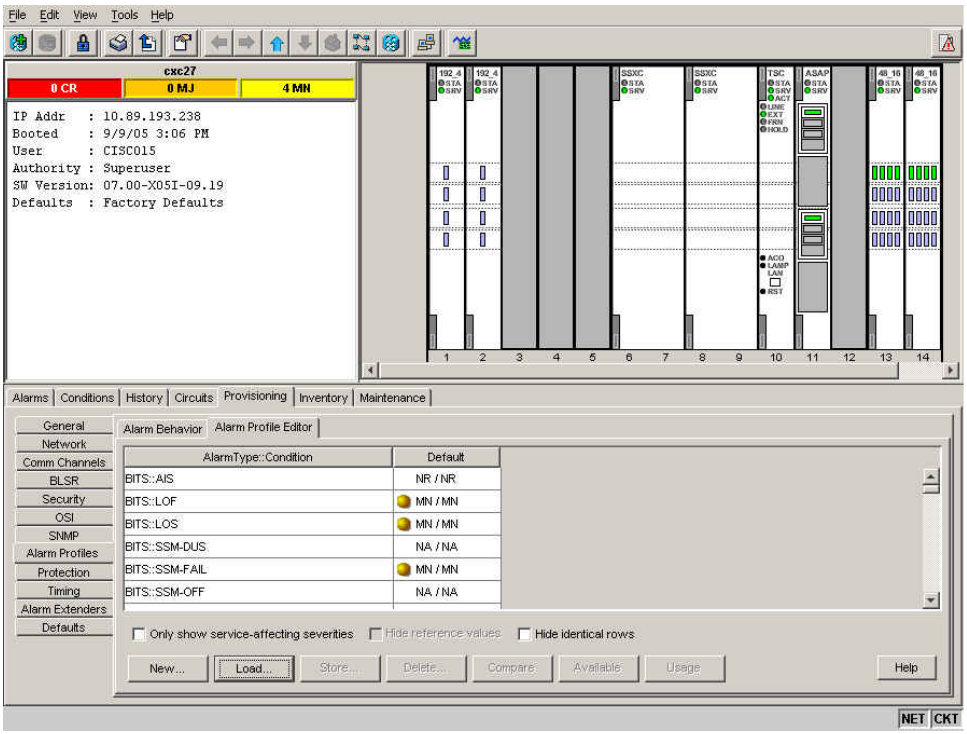
CTC can store up to ten active alarm profiles at any time to apply to the node. Custom profiles can take eight of these active profile positions. Two other profiles, Default profile and Inherited profile, are reserved by the network element (NE), and cannot be edited. The reserved Default profile contains Telcordia GR-474-CORE severities. The reserved Inherited profile allows port alarm severities to be governed by the card-level severities or card alarm severities to be determined by the node-level severities.

If one or more alarm profiles have been stored as files from elsewhere in the network onto the local PC or server hard drive where CTC resides, you can utilize as many profiles as you can physically store by deleting and replacing them locally in CTC so that only eight are active at any given time.

11.3.1 Alarm Profile Window

Alarm profiles are created in the network view using the Provisioning > Alarm Profiles tabs. A default alarm profile (in the Default column) is preprovisioned for every alarm. After loading the default profile on the node, you can use the Clone feature to create new profiles based on the default alarm profile. After the new profile is created, the Alarm Profiles window shows the default profile and the new profile.

Figure 11-5 Node View Alarm Profiles Window Showing the Default Profiles of Listed Alarms



11.3.2 Alarm Profile Buttons

The Alarm Profiles window has six buttons at the bottom. Table 11-8 describes each of the alarm profile buttons.

Table 11-8 Alarm Profile Buttons

Button	Description
New	Adds a new alarm profile.
Load	Loads a profile to a node or a file.
Store	Saves profiles on a node (or nodes) or in a file.
Delete	Deletes profiles from a node.
Compare	Displays differences between alarm profiles (individual alarms that are not configured equivalently between profiles).
Available	Displays all profiles available on each node.
Usage	Displays all entities (nodes and alarm subjects) present in the network and which profiles contain the alarm (can be printed).

11.3.3 Alarm Profile Editing

Table 11-9 describes the five profile-editing options available when you right-click an alarm item in the profile column (such as Default).

Table 11-9 Alarm Profile Editing Options

Button	Description
Store	Saves a profile in a node or in a file.
Rename	Changes a profile name.
Clone	Creates a new profile that contains the same alarm severity settings as the profile being cloned.
Reset	Restores a profile to its previous state or to the original state (if it has not yet been applied).
Remove	Removes a profile from the table editor.

11.3.4 Alarm Severity Option

To change or assign alarm severity, left-click the alarm severity you want to change in the alarm profile column. Seven severity levels appear for the alarm:

- Not Reported (NR)
- Not Alarmed (NA)
- Minor (MN)
- Major (MJ)
- Critical (CR)
- Use Default
- Transient (T)

Transient and Use Default severity levels only appear in alarm profiles. They do not appear when you view alarms, history, or conditions.

11.3.5 Row Display Options

In the network view, the Alarm Profiles window has two check boxes at the bottom of the window:

- Hide reference values—Highlights alarms with non-default severities by clearing alarm cells with default severities. This check-box is normally greyed out. It becomes active only when more than one profile is listed in the Alarm Profile Editor window. (The check box text changes to “Hide Values matching profile Default” in this case.)
- Hide identical rows—Hides rows of alarms that contain the same severity for each profile.

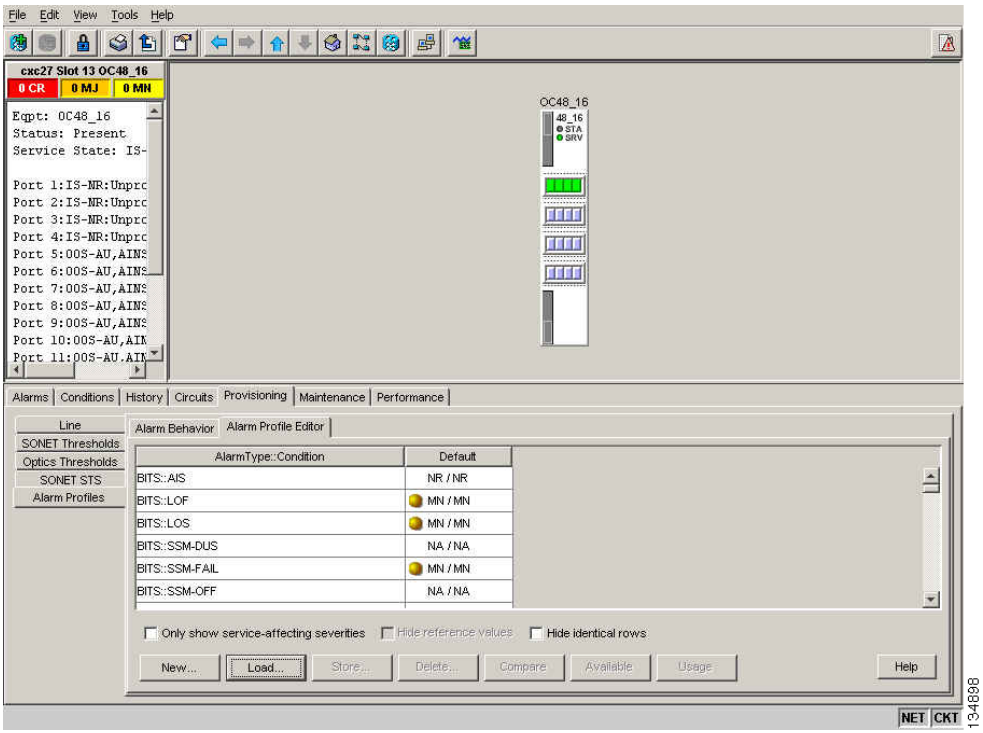
11.3.6 Alarm Profile Applications

In CTC node view, the Provisioning > Alarm Profiles > Alarm Profile Editor window displays alarm profiles for the node, and in card view this windows displays the alarm profiles for the selected card.

Alarm profiles form a hierarchy. A node-level alarm profile applies to all cards in the node except cards that have their own profiles. A card-level alarm profile applies to all ports on the card except ports that have their own profiles.

At the node level, you can apply profile changes on a card-by-card basis or set a profile for the entire node. At the card-level view, you can apply profile changes on a port-by-port basis for all ports on that card. Figure 11-6 shows an OC48 card view of an alarm profile.

Figure 11-6 Alarm Profile on an OC48_16 Card



11.4 Alarm Filter

Alarm display can be filtered to keep particular alarm severities, or alarms that occur between certain dates, from appearing in the Alarms window (Figure 11-2 on page 11-5). You can set the parameters of the filter by clicking Filter at the bottom-left of the Alarms window. You can turn the filter on or off by clicking the Filter icon button at the bottom-right of the window. CTC retains your filter activation setting. For example, if you turn the filter on and then log out, CTC makes the filter active the next time your user ID is activated.

11.5 Alarm Suppression

The following sections explain alarm suppression features for the ONS 15600.

11.5.1 Alarms Suppressed for Maintenance

When you place a port in OOS,MT administrative state, this raises the alarm suppressed for maintenance (AS-MT) alarm in the Conditions and History windows[1] and causes subsequently raised alarms for that port to be suppressed.

While the facility is in the OOS,MT state, any alarms or conditions that are raised and suppressed on it (for example, a transmit failure [TRMT] alarm) are reported in the Conditions window and show their normal severity in the Sev column. The suppressed alarms are not shown in the Alarms and History windows. (These windows only show AS-MT). When you place the port back into IS,AINS administrative state, the AS-MT alarm is resolved in all three windows. Suppressed alarms remain raised in the Conditions window until they are cleared.

11.5.2 Alarms Suppressed by User Command

In the Provisioning > Alarm Profiles > Alarm Behavior tabs, the ONS 15600 has an alarm suppression option that clears raised alarm messages for the node, chassis, one or more slots (cards), or one or more ports. Using this option raises the alarms suppressed by user command, or AS-CMD alarm. The AS-CMD alarm, like the AS-MT alarm, appears in the Conditions, and History[1] windows. Suppressed conditions (including alarms) appear only in the Conditions window--showing their normal severity in the Sev column. When the Suppress Alarms check box is unchecked, the AS-CMD alarm is cleared from all three windows.

A suppression command applied at a higher level does not supersede a command applied at a lower level. For example, applying a node-level alarm suppression command makes all raised alarms for the node appear to be cleared, but it does not cancel out card-level or port-level suppression. Each of these conditions can exist independently and must be cleared independently.

Caution Use alarm suppression with caution. If multiple CTC or TL1 sessions are open, suppressing the alarms in one session suppresses the alarms in all other open sessions.

Note When an entity is put in the OOS,MT administrative state, the ONS 15600 suppresses all standing alarms on that entity. All alarms and events appear on the Conditions tab. You can change this behavior for the LPBKFACILITY and LPBKTERMINAL alarms. To display these alarms on the Alarms tab, set the NODE.general.ReportLoopbackConditionsOnPortsInOOS-MT to TRUE on the NE Defaults tab.

11.6 External Alarms and Controls

External alarm inputs are used for external sensors such as open doors and flood sensors, temperature sensors, and other environmental conditions. External control outputs allow you to drive external visual or audible devices such as bells and lights. They can control other devices such as generators, heaters, and fans.

You provision external alarms and controls in the node view Maintenance > Alarm Extenders window. Up to 16 external alarm inputs and 16 external controls are available. The external input/output contacts are located on the CAP attached to the ONS 15600 backplane.

1. AS-MT can be seen in the Alarms window as well if you have set the Filter dialog box to show NA severity events.

11.6.1 External Alarm Input

You can provision each alarm input separately. Provisionable characteristics of external alarm inputs include:

- Alarm type
- Alarm severity (CR, MJ, MN, NA, and NR)
- Alarm-trigger setting (open or closed)
- Virtual wire associated with the alarm
- CTC alarm log description (up to 63 characters)

11.6.2 External Control Output

You can provision each alarm output separately. Provisionable characteristics of alarm outputs include:

- Control type
- Trigger type (alarm or virtual wire)
- Description for CTC
- Closure setting (manually or by trigger). If you provision the output closure to be triggered, the following characteristics can be used as triggers:
  - Local NE alarm severity—A chosen alarm severity (for example, Major) and any higher-severity alarm (in this case, Critical) causes output closure.
  - Remote NE alarm severity—Similar to local NE alarm severity trigger setting, but applies to remote alarms.
  - Virtual wire entities—You can provision an alarm that is input to a virtual wire to trigger an external control output.

11.6.3 Virtual Wires for External Alarms in Mixed Networks

Virtual wires route external alarms to one or more alarm collection centers in a network. External alarms can be assigned to virtual wires in networks containing only ONS 15600s or in mixed networks containing ONS 15600s, ONS 15454s, and ONS 15327s. You can view virtual wires in the CTC node view Maintenance > Alarm Extenders > Virtual Wires window.

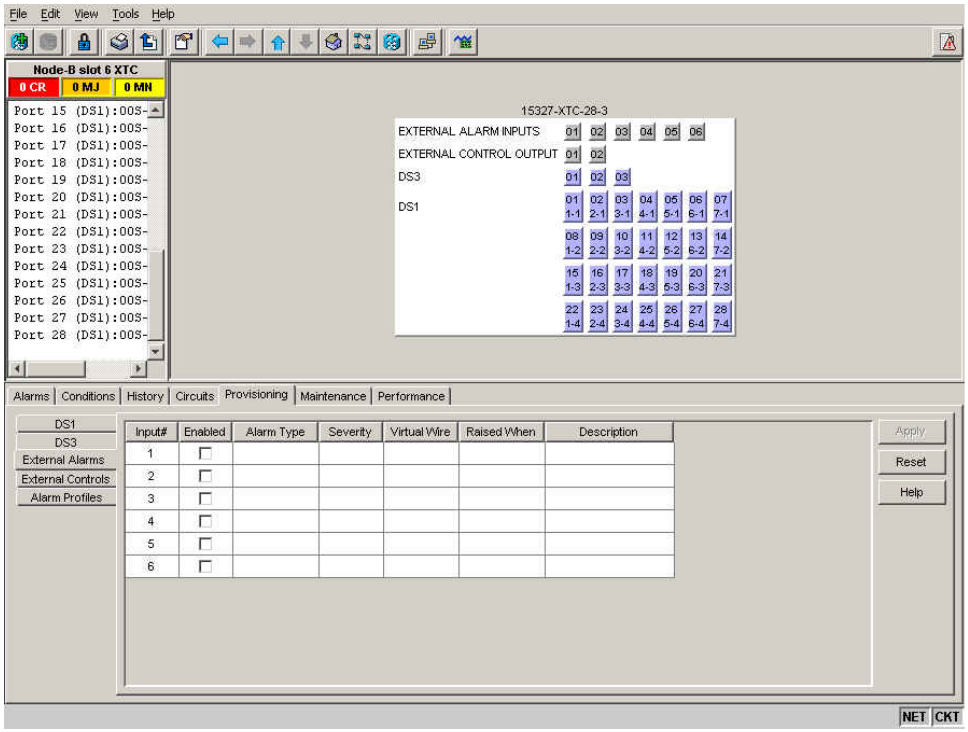
When using virtual wires, you can:

- Assign different external devices to the same virtual wire.
- Assign virtual wires as the trigger type for different external controls.

The ONS 15600 supports 16 virtual wires. The ONS 15454 and ONS 15327 each support four virtual wires. In mixed ONS 15600/15454/15327 networks, CTC displays the virtual wire information differently based upon where it is viewed.

Figure 11-7 shows an ONS 15600 Virtual Wires window with a DCC connection to an ONS 15454 node. The Virtual Wires window shows 10 virtual wire columns, but 16 are available. The first 12 are available for other ONS 15600s. Only the last four are available for the ONS 15454, because it can only support four virtual wires.

Figure 11-7 Virtual Wires Seen from an ONS 15600



CHAPTER 12

Performance Monitoring

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

Use performance monitoring (PM) parameters to gather, store, threshold, and report performance data for early detection of problems. This chapter defines PM parameters and concepts for Cisco ONS 15600 optical cards.

Note For additional information regarding PM parameters, refer to Telcordia documents GR-1230-CORE, GR-820-CORE, GR-499-CORE, and GR-253-CORE and the ANSI T1.231 document entitled *Digital Hierarchy - Layer 1 In-Service Digital Transmission Performance Monitoring*.

For information about enabling and viewing PM values, refer to the *Cisco ONS 15600 Procedure Guide.*

Chapter topics include:

- 12.1 Threshold Performance Monitoring, page 12-1
- 12.2 Intermediate-Path Performance Monitoring, page 12-2
- 12.3 Pointer Justification Count, page 12-4
- 12.4 Performance-Monitoring Parameter Definitions, page 12-5
- 12.5 Optical Card Performance Monitoring, page 12-9
- 12.6 ASAP Card Performance Monitoring, page 12-11

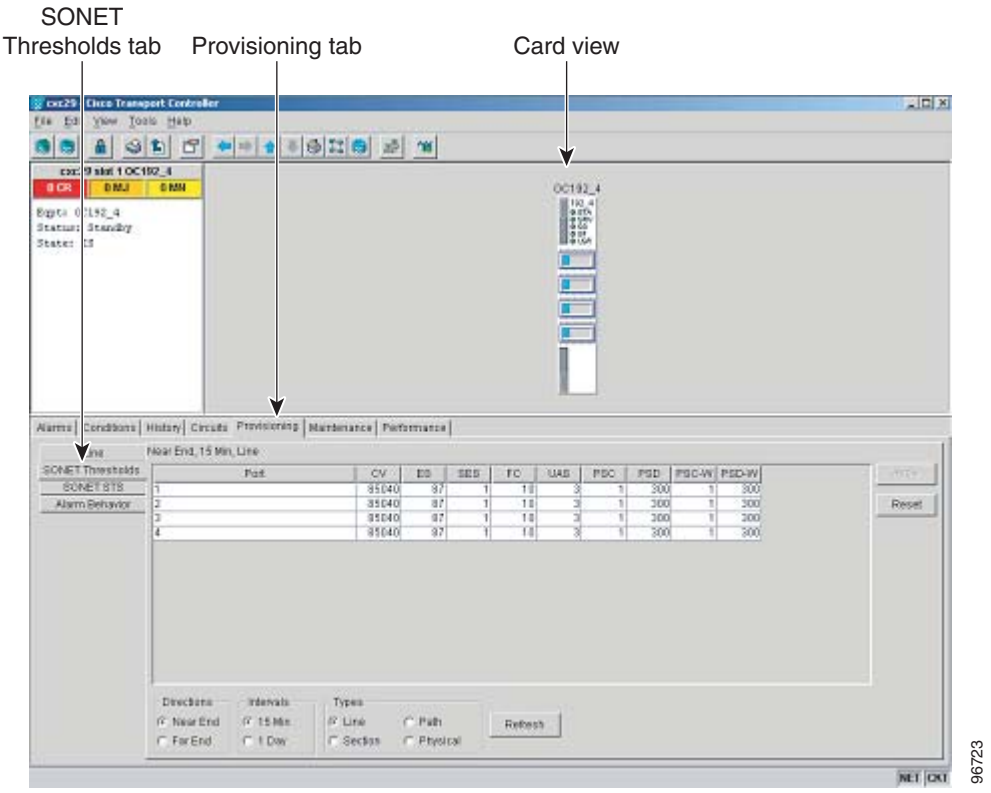
12.1 Threshold Performance Monitoring

Thresholds are used to set error levels for each PM. You can program PM threshold ranges from the Provisioning > SONET Thresholds tabs on the Cisco Transport Controller (CTC) card view. To provision card thresholds, such as line, path, and SONET thresholds, refer to the *Cisco ONS 15600 Procedure Guide*.

During the accumulation cycle, if the current value of a performance monitoring parameter reaches or exceeds its corresponding threshold value, a threshold crossing alert (TCA) is generated by the node and sent to CTC. TCAs provide early detection of performance degradation. When a threshold is crossed,

the node continues to count the errors during a given accumulation period. If 0 is entered as the threshold value, the performance monitoring parameter is disabled. Figure 12-1 shows the Provisioning > SONET Thresholds tabs for an OC-48/STM-16 card.

Figure 12-1 SONET Thresholds Tab for Setting Threshold Values



Change the threshold if the default value does not satisfy your error monitoring needs. For example, customers with a critical STS-1 installed for 911 calls must guarantee the best quality of service on the line; therefore, they lower all thresholds so that the slightest error raises a TCA.

12.2 Intermediate-Path Performance Monitoring

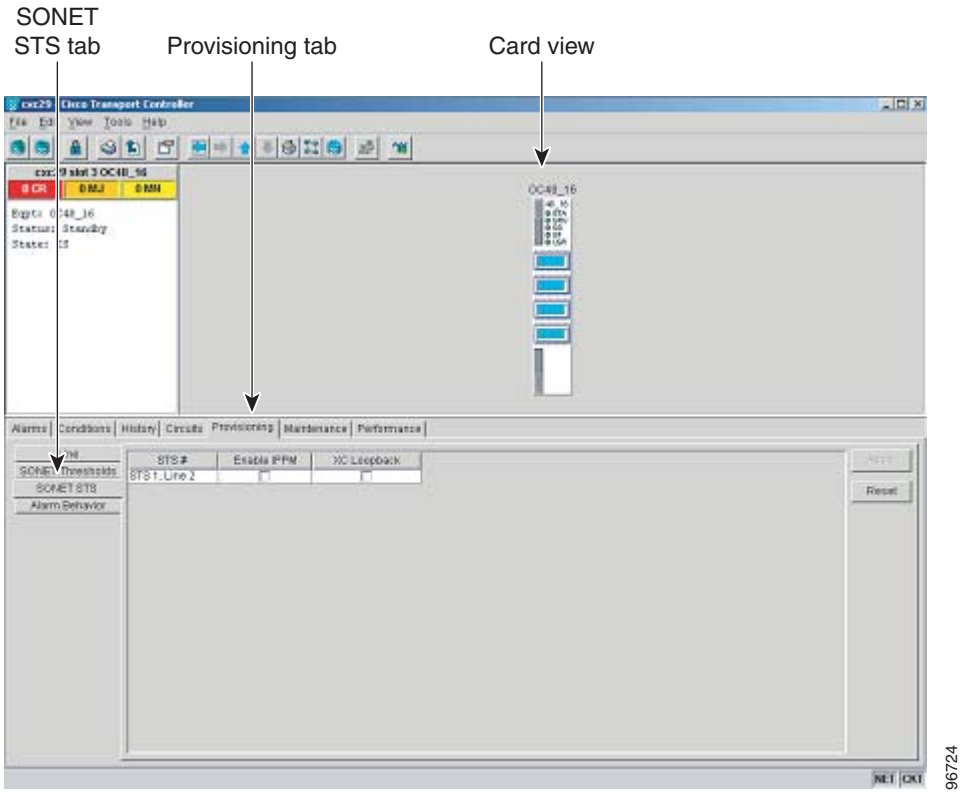
Intermediate-path performance monitoring (IPPM) allows a nonterminating node to transparently monitor a constituent channel of an incoming transmission signal. ONS 15600 networks only use line terminating equipment (LTE), not path terminating equipment (PTE). Table 12-1 shows ONS 15600 cards that are considered LTEs.

Table 12-1 Line Terminating Traffic Cards

Line Terminating Equipment
OC48/STM16 SR/SH 16 Port 1310
OC48/STM16 LR/LH 16 Port 1550
OC192/STM64 SR/SH 4 Port 1310
OC192/STM64 LR/LH 4 Port 1550

Figure 12-2 shows the Provisioning > SONET STS tabs for an OC-48 card.

Figure 12-2 STS Tab for Enabling IPPM



IPPM enables LTE cards to monitor near-end path PM data on individual synchronous transport signal (STS) payloads. After enabling IPPM on provisioned STS ports, service providers can monitor large amounts of STS traffic through intermediate nodes, thus making troubleshooting and maintenance activities more efficient.

IPPM occurs only on STS paths that have IPPM enabled, and TCAs are raised only for PM parameters on the selected IPPM paths. The monitored IPPMs are STS CV-P, STS ES-P, STS SES-P, STS UAS-P, and STS FC-P. To enable IPPM, refer to the *Cisco ONS 15600 Procedure Guide*.

The ONS 15600 performs IPPM by examining the overhead in the monitored path and reading all of the near-end path performance monitoring parameters in the incoming transmission direction. The IPPM process allows the path overhead to pass bidirectionally through the node completely unaltered.

For detailed information about specific performance monitoring parameters, see the "12.4 Performance-Monitoring Parameter Definitions" section on page 12-5.

12.3 Pointer Justification Count

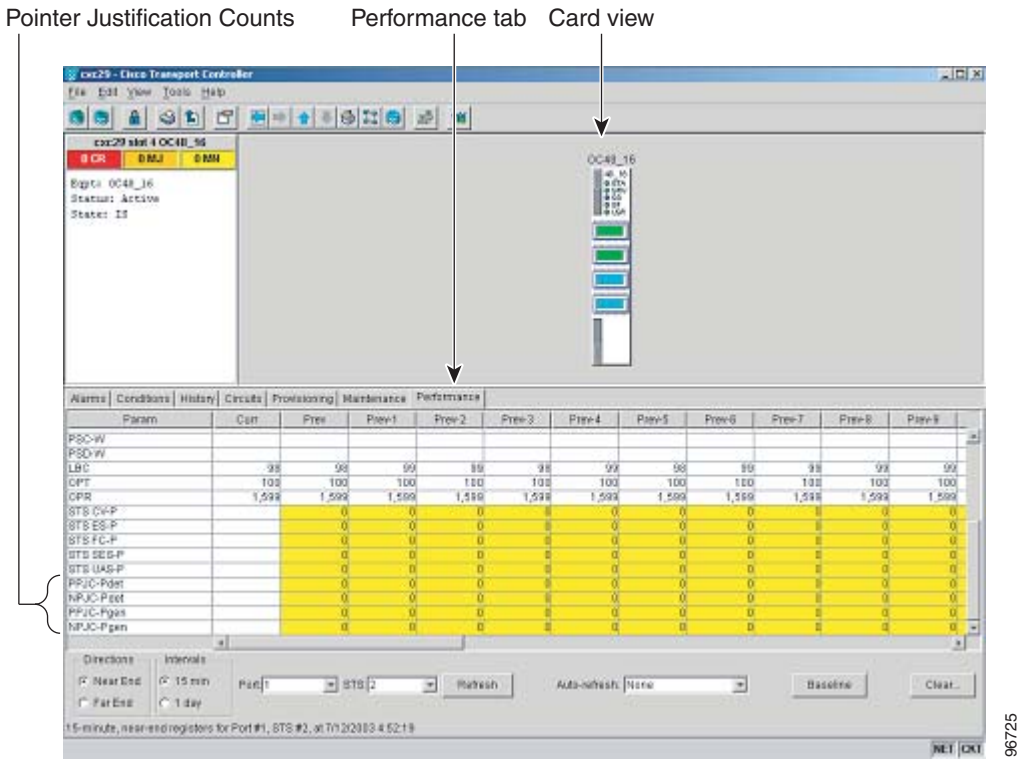
Pointers are used to compensate for frequency and phase variations. Pointer justification counts indicate timing differences on SONET networks. When a network is not synchronized, frequency and phase variations occur on the transported signal. Excessive frequency and phase variations can cause terminating equipment to slip. These variations also cause slips at the SDH and plesiosynchronous digital hierarchy (PDH) boundaries.

Slips cause different effects in service. Voice service has intermittent audible clicks. Compressed voice technology has short transmission errors or dropped calls. Fax machines lose scanned lines or experience dropped calls. Digital video transmission has distorted pictures or frozen frames. Encryption service loses the encryption key, which causes data to be transmitted again.

Pointers align the phase variations in STS and Virtual Tributary (VT) payloads. The STS payload pointer is located in the H1 and H2 bytes of the line overhead. Clocking differences are measured by the offset in bytes from the pointer to the first byte of the STS synchronous payload envelope (SPE) called the J1 byte. A small number of pointer justification counts per day is not cause for concern. If the pointer justification count continues to rise or becomes large, action must be taken to correct the problem.

Figure 12-3 shows pointer justification count parameters on the performance monitoring window. You can enable positive pointer justification count (PPJC) and negative pointer justification count (NPJC) performance monitoring parameters for LTE cards.

Figure 12-3 Viewing Pointer Justification Count Parameters



PPJC is a count of path-detected (PPJC-Pdet) or path-generated (PPJC-Pgen) positive pointer justifications depending on the specific PM name. NPJC is a count of path-detected (NPJC-Pdet) or path-generated (NPJC-Pgen) negative pointer justifications depending on the specific PM name.

A consistent pointer justification count indicates clock synchronization problems between nodes. A difference between the counts means the node transmitting the original pointer justification has timing variations with the node detecting and transmitting this count. Positive pointer adjustments occur when the frame rate of the SPE is too slow in relation to the rate of the STS-1.

For pointer justification count definitions, see the "12.4 Performance-Monitoring Parameter Definitions" section on page 12-5. In CTC, the PM count fields for PPJC and NPJC appear white and blank unless IPPM is enabled.

12.4 Performance-Monitoring Parameter Definitions

Table 12-2 gives definitions for each type of performance-monitoring parameter found in this chapter.

Table 12-2 Performance Monitoring Parameters

Parameter	Definition
CV-L	Line Code Violation (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of bipolar violations (BPVs) and excessive zeros (EXZs) occurring over the accumulation period.
CV-LFE	Far-End Line Code Violation (CV-LFE) is a count of bit interleaved parity (BIP) errors detected by the far-end LTE and reported back to the near-end LTE using the Line remote error indication (REI-L) in the line overhead. For SONET signals at rates below OC-48, up to 8 x n BIP errors per STS-N frame can be indicated using the RDI-L indication. For OC-48 signals, up to 255 BIP errors per STS-N frame can be indicated. The current CV-L second register is incremented for each BIP error indicated by the incoming REI-L.
CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (that is, using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
CV-PFE	Far-End STS Path Coding Violations (CV-PFE) is a count of BIP errors detected at the STS path layer (that is, using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-PFE second register.
CV-S	Section Coding Violation (CV-S) is a count of BIP errors detected at the section layer (that is, using the B1 byte in the incoming SONET signal). Up to eight section BIP errors can be detected per STS-N frame; each error increments the current CV-S second register.
ES-L	Line Errored Seconds (ES-L) is a count of the seconds containing one or more anomalies (BPV+EXZ) and/or defects (that is, loss of signal) on the line.
ES-LFE	Far-End Line Errored Seconds (ES-LFE) is a count of the seconds when at least one line-layer BIP error was reported by the far-end LTE or a RDI-L defect was present.
ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an ES-P.

Table 12-2 Performance Monitoring Parameters (continued)

Parameter	Definition
ES-PFE	Far-End STS Path Errored Seconds (ES-PFE) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, far-end defect) or an LOP-P defect can also cause an STS ES-PFE.
ES-S	Section Errored Seconds (ES-S) is a count of the number of seconds when at least one section-layer BIP error was detected or an SEF or LOS defect was present.
FC-L	Line Failure Count (FC-L) is a count of the number of near-end line failure events. A failure event begins when an AIS-L failure is declared or when a lower-layer, traffic-related, near-end failure is declared. This failure event ends when the failure is cleared. A failure event that begins in one period and ends in another period is counted only in the period where it begins.
FC-LFE	Far-End Line Failure Count (FC-LFE) is a count of the number of far-end line failure events. A failure event begins when Line RFI-L failure is declared, and it ends when the RFI-L failure clears. A failure event that begins in one period and ends in another period is counted only in the period where it began.
FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P failure, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
FC-PFE	Far-End STS Path Failure Counts (FC-PFE) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P failure, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
LBC	Laser Bias Current (LBC) is represented by the percentage of the normal (100%) laser bias current of the laser on the card port. The high laser bias current (LBC-HIGH) threshold is the percentage of the normal laser bias current when a high current TCA occurs. The low laser bias current (LBC-LOW) threshold is the percentage of the normal laser bias current when a low current TCA occurs.
NPJC-PDET	Negative Pointer Justification Count, STS Detected (NPJC-PDET).
NPJC-PDET-P	Negative Pointer Justification Count, STS Path Detected (NPJC-Pdet-P) is a count of the negative pointer justifications detected on a particular path in an incoming SONET signal.
NPJC-PGEN-P	Negative Pointer Justification Count, STS Path Generated (NPJC-Pgen-P) is a count of the negative pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
OPT	Optical Power Transmitted (OPT) is represented by the percentage of the normal (100%) optical transmit power of the laser on the card port. The high optical power transmitted (OPT-HIGH) threshold is the percentage of the normal transmit optical power when a high transmit power TCA occurs. The low optical power transmitted (OPT-LOW) threshold is the percentage of the normal transmit optical power when a low transmit power TCA occurs.

Table 12-2 Performance Monitoring Parameters (continued)

Parameter	Definition
OPR	Optical Power Received (OPR) is represented by the percentage of the normal optical receive power of the card port. The high optical power received (OPR-HIGH) threshold is the percentage of the calibrated receive optical power when a high receive power TCA occurs. The low optical power received (OPR-LOW) threshold is the percentage of the calibrated receive optical power when a low receive power TCA occurs.
PPJC-PDET	Pointer Justification STS Detected (PPJC-PDET).
PPJC-PDET-P	Positive Pointer Justification Count, STS Path Detected (PPJC-Pdet-P) is a count of the positive pointer justifications detected on a particular path in an incoming SONET signal.
PPJC-PGEN-P	Positive Pointer Justification Count, STS Path Generated (PPJC-Pgen-P) is a count of the positive pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
PSC (1+1)	In a 1+1 protection scheme for a working port, Protection Switching Count (PSC) is a count of the number of times service switches from a working port to a protection port plus the number of times service switches back to the working port. For a protection port, PSC is a count of the number of times service switches to a working port from a protection port plus the number of times service switches back to the protection port. The PSC PM is only applicable if revertive line-level protection switching is used.
PSC (BLSR)	For a protect line in a two-fiber ring, Protection Switching Count (PSC) refers to the number of times a protection switch has occurred either to a particular span's line protection or away from a particular span's line protection. Therefore, if a protection switch occurs on a two-fiber BLSR, the PSC of the protection span to which the traffic is switched will increment, and when the switched traffic returns to its original working span from the protect span, the PSC of the protect span will increment again.
PSC-R	In a four-fiber bidirectional line switched ring (BLSR), Protection Switching Count-Ring (PSC-R) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to a working line. A count is only incremented if ring switching is used.
PSC-S	In a four-fiber BLSR, Protection Switching Count-Span (PSC-S) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. A count is only incremented if span switching is used.
PSC-W	For a working line in a two-fiber BLSR, Protection Switching Count-Working (PSC-W) is a count of the number of times traffic switches away from the working capacity in the failed line and back to the working capacity after the failure is cleared. PSC-W increments on the failed working line and PSC increments on the active protect line. For a working line in a four-fiber BLSR, PSC-W is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. PSC-W increments on the failed line and PSC-R or PSC-S increments on the active protect line.

Table 12-2 Performance Monitoring Parameters (continued)

Parameter	Definition
PSD (1+1)	In a 1+1 protection scheme, Protection Switching Duration (PSD) applies to the length of time, in seconds, that service is carried on another line. For a working line, PSD is a count of the number of seconds that service was carried on the protection line. For the protection line, PSD is a count of the seconds that the line was used to carry service. The PSD PM is only applicable if revertive line-level protection switching is used.
PSD (BLSR)	Protection Switching Duration (PSD) applies to the length of time, in seconds, that service is carried on another line. For a working line, PSD is a count of the number of seconds that service was carried on the protection line. For the protection line, PSD is a count of the seconds that the line was used to carry service. The PSD PM is only applicable if revertive line-level protection switching is used. Therefore, if a protection switch occurs on a two-fiber BLSR, the PSD of the protection span to which the traffic is switched will increment, and when the switched traffic returns to its original working span from the protect span, the PSD of the protect span will stop incrementing.
PSD-R	In a four-fiber BLSR, Protection Switching Duration-Ring (PSD-R) is a count of the seconds that the protection line was used to carry service. A count is only incremented if ring switching is used.
PSD-S	In a four-fiber BLSR, Protection Switching Duration-Span (PSD-S) is a count of the seconds that the protection line was used to carry service. A count is only incremented if span switching is used.
PSD-W	For a working line in a two-fiber BLSR Protection Switching Duration-Working (PSD-W) is a count of the number of seconds that service was carried on the protection line. PSD-W increments on the failed working line and PSD increments on the active protect line.
SEFS-S	Section Severely Errored Framing Seconds (SEFS-S) is a count of the seconds when an SEF defect was present. An SEF defect is expected to be present during most seconds when an LOS or loss of frame (LOF) defect is present. However, there can be situations when the SEFS-S parameter is only incremented based on the presence of the Severely Errored Framing (SEF) defect.
SES-L	Line Severely Errored Seconds (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ $\geq$ 1544) and/or defects on the line.
SES-LFE	Far-End Line Severely Errored Seconds (SES-LFE) is a count of the seconds when K (see Telcordia GR-253-CORE for values) or more line-layer BIP errors were reported by the far-end LTE or an RDI-L defect was present.
SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an SES-P.

Table 12-2 Performance Monitoring Parameters (continued)

Parameter	Definition
SES-PFE	Far-End STS Path Severely Errored Seconds (SES-PFE) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, far-end defect) or an LOP-P defect can also cause an SES-PFE.
SES-S	Section Severely Errored Seconds (SES-S) is a count of the seconds when K (see Telcordia GR-253-CORE for value) or more section-layer BIP errors were detected or an SEF or LOS defect was present.
UAS-L	Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable. A line becomes unavailable when ten consecutive seconds occur that qualify as SES-Ls, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ls.
UAS-LFE	Far-End Line Unavailable Seconds (UAS-LFE) is a count of the seconds when the line is unavailable at the far end. A line becomes unavailable at the onset of ten consecutive seconds that qualify as SES-LFEs, and continues to be unavailable until the onset of ten consecutive seconds occurs that do not qualify as SES-LFEs.
UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.
UAS-PFE	Far-End STS Path Unavailable Seconds (UAS-PFE) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-PFEs, and continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-PFEs.

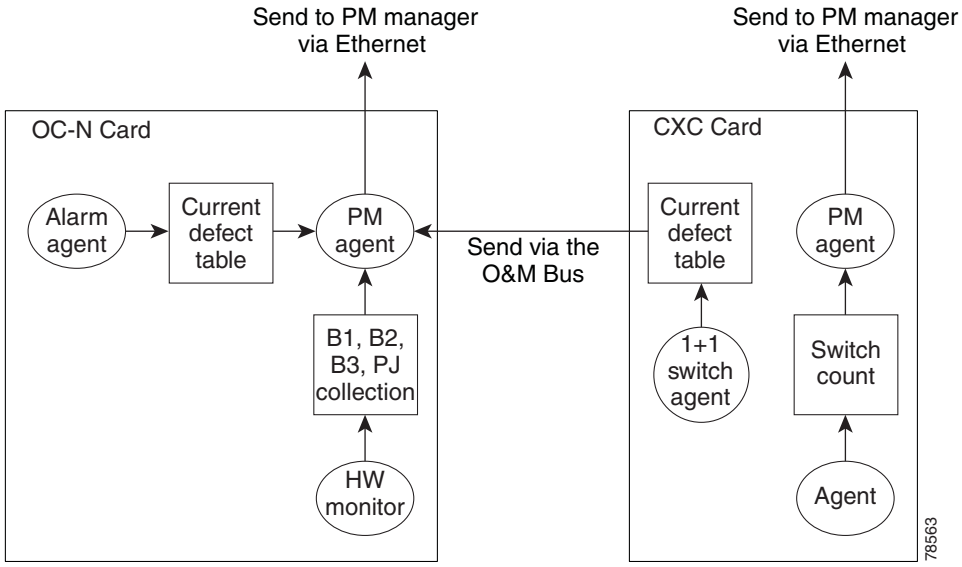
12.5 Optical Card Performance Monitoring

The following sections define performance monitoring parameters for the OC-48/STM16 and OC-192/STM64 optical cards.

12.5.1 OC-48/STM16 and OC-192/STM64 Card Performance Monitoring Parameters

Figure 12-4 shows where overhead bytes detected on the Application-Specific Integrated Circuits (ASICs) produce performance monitoring parameters for the OC-48/STM16 and OC-192/STM64 optical cards.

Figure 12-4 PM Read Points on the OC-48/STM16 and OC-192/STM64 Cards



Note For PM locations relating to protection switch counts, see the Telcordia GR-1230-CORE document.

Table 12-3 lists the near-end and far-end section layer PMs.

Table 12-3 OC48/STM16 and OC-192/STM64 Card PMs

Section (NE)	Line (NE)	STS Path (NE)[1, 2]	Line (FE)	Optics (NE)[3, 4]	STS Path (FE)
CV-S	CV-L	CV-P	CV-LFE	OPT	CV-PFE
ES-S	ES-L	ES-P	ES-LFE	OPR	ES-PFE
SES-S	SES-L	SES-P	SES-LFE	LBC[5]	SES-PFE
SEF-S	UAS-L	UAS-P	UAS-LFE		UAS-PFE
	FC-L	FC-P	FC-LFE		FC-PFE
	PSC (1+1)	PPJC-PDET			
	PSC (BLSR)	NPJC-PDET			
	PSD	PPJC-PGEN			
	PSC-W	NPJC-PGEN			
	PSD-W				

1. SONET path performance monitoring parameters increment only if IPPM is enabled. For additional information, see the "12.2 Intermediate-Path Performance Monitoring" section on page 12-2. To monitor SONET path performance monitoring parameters, log into the far-end node directly.
2. For information about troubleshooting path protection switch counts, see For information about creating circuits with protection switching, refer to the *Cisco ONS 15600 Reference Manual*.
3. The normalized physical layer performance parameters are represented as a percentage of the nominal operating value, with 100 representing the nominal value
4. To set the threshold values for LBC, OPT, and OPR, and to reset the OPR nominal value for future calculation, refer to the *Cisco ONS 15600 Procedure Guide*.
5. As stated in Telcordia GR-253-CORE, the LBC (TCA) PM value is not appropriate for use with some optical transmitter technologies. Such is the case for Cisco's uncooled SR optical transmitters. The default LBC TCA provides safe operating parameter for both of Cisco's cooled and uncooled transmitters.

12.5.2 Physical Layer Parameters

The ONS 15600 retrieves the OPR, OPT, and LBC from the line card and stores these values with the PM counts for the 15-minute and 1-day periods. You can retrieve current OPR, OPT, and LBC values for each port by displaying the card view in CTC and clicking the Maintenance > Transceiver tabs.

The physical layer performance parameters consist of normalized and non-normalized values of LBC, OPT, and OPR. Table 12-4 defines the non-normalized values.

Table 12-4 Non-Normalized Transceiver Physical Optics for the OC-48/STM16 and OC-192/STM64 Cards

Parameter	Definition
Non-normalized LBC (mA)[1]	The actual operating value of laser bias current (mA) for the specified card port.
Non-normalized OPR (dbm)[2]	The actual operating value of optical power received (dBm) for the specified card port.
Non-normalized OPT (dbm)[1]	The actual operating value of optical power transmitted (dBm) for the specified card port.

1. This value should be somewhat consistent from port to port and cannot be configured.
2. This value will vary from port to port because of received optical signal power differences. This value can be configured by calibrating the nominal value to the initial receive power level when the port is put in service.

12.6 ASAP Card Performance Monitoring

The following sections define performance monitoring parameters for the Any Service Any Port (ASAP) card.

12.6.1 ASAP Card Optical Performance Monitoring Parameters

Table 12-5 lists the near-end and far-end section layer PMs.

Table 12-5 ASAP Card PMs

Section (NE)	Line (NE)	STS Path (NE)[1,2]	Line (FE)	Optics (NE)[3,4]	STS Path (FE)
CV-S	CV-L	CV-P	CV-L	OP	STS CV-P
ES-S	ES-L	ES-P	ES-L	OPR %	STS ES-P
SES-S	SES-L	SES-P	SES-L	LBC %[5]	STS SES-P
SEF-S	UAS-L	UAS-P	UAS-L		STS UAS-P
	FC-L	FC-P	FC-L		STS FC-P
	PSC	PPJC-PDET			
	PSD	NPJC-PDET			
	PSC-S	PPJC-PGEN			
	PSC-R	NPJC-PGEN			
	PSD-S				
	PSD-R				
	PSC-W				
	PSD-W				

1. SONET path performance monitoring parameters increment only if IPPM is enabled. For additional information, see the "12.2 Intermediate-Path Performance Monitoring" section on page 12-2. To monitor SONET path performance monitoring parameters, log into the far-end node directly.
2. For information about troubleshooting path protection switch counts, refer to the *Cisco ONS 15600 Troubleshooting Guide*.
3. The normalized physical layer performance parameters are represented as a percentage of the nominal operating value, with 100 representing the nominal value
4. To set the threshold values for LBC, OPT, and OPR, and to reset the OPR nominal value for future calculation, refer to the *Cisco ONS 15600 Procedure Guide*.
5. As stated in Telcordia GR-253-CORE, the LBC (TCA) PM value is not appropriate for use with some optical transmitter technologies. Such is the case for Cisco's uncooled SR optical transmitters. The default LBC TCA provides safe operating parameter for both of Cisco's cooled and uncooled transmitters.

12.6.2 ASAP Card Ethernet Performance Monitoring Parameters

CTC provides Ethernet performance information, including line-level parameters, port bandwidth consumption, and historical Ethernet statistics. The ASAP card Ethernet performance information is divided into Ether Ports and POS Ports windows within the card view Performance tab window.

12.6.2.1 ASAP Card Ether Port Statistics Window

The Ethernet Ether Ports statistics window lists Ethernet parameters at the line level. The Statistics window provides buttons to change the statistical values. The Baseline button resets the displayed statistics values to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval at which automatic refresh occurs. The ASAP Statistics window also has a Clear button. The Clear button sets the values on the card to zero, but does not reset the ASAP card.

During each automatic cycle, whether auto-refreshed or manually refreshed (using the Refresh button), statistics are added cumulatively and are not immediately adjusted to equal total received packets until testing ends. To see the final PM count totals, allow a few moments for the PM window statistics to finish testing and update fully. PM counts are also listed in the ASAP card Performance > History window.

Table 12-6 defines the ASAP card statistics parameters.

Table 12-6 ASAP Ethernet Statistics Parameters

Parameter	Meaning
Time Last Cleared	A time stamp indicating the last time statistics were reset.
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present.
Rx Unicast Packets	Number of unicast packets received since the last counter reset.
Tx Unicast Packets	Number of unicast packets transmitted since the last counter reset.
Rx Multicast Packets	Number of multicast packets received since the last counter reset.
Tx Multicast Packets	Number of multicast packets transmitted since the last counter reset.
Rx Broadcast Packets	Number of broadcast packets received since the last counter reset.

Table 12-6 ASAP Ethernet Statistics Parameters (continued)

Parameter	Meaning
Tx Multicast Packets	Number of broadcast packets transmitted since the last counter reset.
Rx Bytes	Number of bytes received since the last counter reset.
Tx Bytes	Number of bytes transmitted since the last counter reset.
Rx Errors	The number of inbound packets (or transmission units), that could not be delivered to a higher-layer protocol because of errors.
Tx Errors	The number of outbound packets (or transmission units), that could not be transmitted because of errors.
Rx FCS errors	Number of packets with a frame check sequence (FCS) error. FCS errors indicate frame corruption during transmission.
Rx Align errors	Number of packets with received incomplete frames.
Rx Runts	The total number of packets received that were less than 64 bytes long (excluding framing bits, but including FCS bytes) and were otherwise well formed.
Rx Jabbers	The total number of packets received that were longer than 1518 bytes (excluding framing bits, but including FCS bytes), and had either a bad FCS with an integral number of bytes (FCS error) or a bad FCS with a nonintegral number of bytes (alignment error).
Rx Giants	The total number of packets received that were longer than 1518 bytes (excluding framing bits, but including FCS bytes) and were otherwise well formed.
Rx Discards	The number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Tx Discards	The number of outbound packets that were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Rx Pause Frames	Number of received Ethernet IEEE 802.3z pause frames.
Tx Pause Frames	Number of transmitted IEEE 802.3z pause frames.
Port Drop Counts	Number of received frames dropped at the port level.
etherStatsDropEvents	Number of received frames dropped at the port level.
etherStatsOctets	The total number of bytes of data (including those in bad packets) received on the network (excluding framing bits but including FCS bytes.
etherStatsPkts	The total number of packets (including bad packets, broadcast packets, and multicast packets) received.

Table 12-6 ASAP Ethernet Statistics Parameters (continued)

Parameter	Meaning
etherStatsBroadcastPkts	The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
etherStatsMulticastPkts	The total number of good packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.
etherStatsFragments	The total number of packets received that were less than 64 bytes in length (excluding framing bits but including FCS bytes) and had either a bad FCS with an integral number of bytes (FCS error) or a bad FCS with a nonintegral number of bytes (alignment error). **Note** It is entirely normal for etherStatsFragments to increment. This is because it counts both runts (which are normal occurrences due to collisions) and noise hits.
etherStatsPkts64Octets	The total number of packets (including bad packets) received that were 64 bytes in length (excluding framing bits but including FCS bytes).
etherStatsPkts65to127Octets	The total number of packets (including bad packets) received that were between 65 and 127 bytes in length inclusive (excluding framing bits but including FCS bytes).
etherStatsPkts128to255Octets	The total number of packets (including bad packets) received that were between 128 and 255 bytes in length inclusive (excluding framing bits but including FCS bytes).
etherStatsPkts256to511Octets	The total number of packets (including bad packets) received that were between 256 and 511 bytes in length inclusive (excluding framing bits but including FCS bytes).
etherStatsPkts512to1023Octets	The total number of packets (including bad packets) received that were between 512 and 1023 bytes in length inclusive (excluding framing bits but including FCS bytes).
etherStatsPkts1024to1518Octets	The total number of packets (including bad packets) received that were between 1024 and 1518 bytes in length inclusive (excluding framing bits but including FCS bytes).
Rx Utilization	The percentage of receive (Rx) line bandwidth used by the Ethernet ports during consecutive time segments.
Tx Utilization	Same as Rx Utilization, except calculated over the transmit (Tx) line bandwidth.
Rx Alignment Errors	A count of frames received on a particular interface that are not an integral number of bytes in length and do not pass the FCS check.
Rx FCS Errors	A count of frames received on a particular interface that are an integral number of bytes in length but do not pass the FCS check.

Table 12-6 ASAP Ethernet Statistics Parameters (continued)

Parameter	Meaning
dot3StatsInternalMacTransmitErrors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error. A frame is only counted by an instance of this object if it is not counted by the corresponding instance of the dot3StatsLateCollisions object, the dot3StatsExcessiveCollisions object, or the dot3StatsCarrierSenseErrors object.
dot3StatsFrameTooLongs	A count of frames received on a particular interface that exceed the maximum permitted frame size.
dot3StatsInternalMacReceiveErrors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error. A frame is only counted by an instance of this object if it is not counted by the corresponding instance of the dot3StatsFrameTooLongs object, the dot3StatsAlignmentErrors object, or the dot3StatsFCSErrors object. The precise meaning of the count represented by an instance of this object is implementation-specific. In particular, an instance of this object may represent a count of receive errors on a particular interface that are not otherwise counted.
dot3StatsSymbolErrors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error. A frame is only counted by an instance of this object if it is not counted by the corresponding instance of either the dot3StatsLateCollisions object, the dot3StatsExcessiveCollisions object, or the dot3StatsCarrierSenseErrors object. The precise meaning of the count represented by an instance of this object is implementation-specific. In particular, an instance of this object might represent a count of transmission errors on a particular interface that are not otherwise counted.

12.6.2.2 ASAP Card Ether Ports Utilization Window

The Ether Ports Utilization window shows the percentage of Tx and Rx line bandwidth used by the Ethernet ports during consecutive time segments. The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets + inPkts * 20) * 8 / 100% interval * maxBaseRate

Tx = (outOctets + outPkts * 20) * 8 / 100% interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is,1 Gbps). Table 12-7 provides the maxBaseRate for ASAP Ethernet cards.

Table 12-7 maxBaseRate for STS Circuits

STS	maxBaseRate
STS-1	51840000
STS-3c	155000000
STS-6c	311000000
STS-12c	622000000

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

12.6.2.3 ASAP Card Ether Ports History Window

The Ethernet Ether Ports History window lists past Ethernet statistics for the previous time intervals. The History window displays the statistics for each port for the number of previous time intervals as shown in Table 12-8. The listed parameters are defined in Table 12-6 on page 12-12.

Table 12-8 Ethernet History Statistics per Time Interval

Time Interval	Number of Intervals Displayed
1 minute	60 previous time intervals
15 minutes	32 previous time intervals
1 hour	24 previous time intervals
1 day (24 hours)	7 previous time intervals

12.6.2.4 ASAP Card POS Ports Statistics Parameters

The Ethernet POS Ports statistics window lists Ethernet POS parameters at the line level.

Table 12-9 defines the ASAP card Ethernet POS Ports parameters.

Table 12-9 ASAP Card POS Ports Parameters

Parameter	Meaning
Time Last Cleared	A time stamp indicating the last time statistics were reset.
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present.
Framing Type	Layer 1 framing, HDLC or GFP
Rx Packets	Number of packets received since the last counter reset.
Tx Packets	Number of packets transmitted since the last counter reset.
Rx Octets	Number of bytes received (from the SONET/SDH path) prior to the bytes undergoing high-level data link control (HLDC) decapsulation by the policy engine.

Table 12-9 ASAP Card POS Ports Parameters (continued)

Parameter	Meaning
Tx Octets	Number of bytes transmitted (to the SONET/SDH path) after the bytes undergoing HLDC encapsulation by the policy engine.
Rx Shorts	Number of packets below the minimum packet size received.
Rx Runts	Total number of frames received that are less than 5 bytes.
Rx Longs	Number of received frames that exceed the maximum transfer unit (MTU).
Rx CRC Errors/HDLC Errors	HDLC errors received from SONET/SDH.
Rx Single Bit Errors	Number of received frames with single bit errors.
Rx Multi Bit Errors	Number of received frames with multibit errors.
Rx Type Invalid	Number of received frames with invalid type.
Rx Input Abort Packets	Number of received packets aborted before input.
Rx Input Drop Packets	Number of received packets dropped before input.

12.6.2.5 ASAP Card POS Ports Utilization Window

The POS Ports Utilization window shows the percentage of Tx and Rx line bandwidth used by the POS ports during consecutive time segments. The Utilization window provides an Interval menu that enables you to set time intervals of 1 minute, 15 minutes, 1 hour, and 1 day. Line utilization is calculated with the following formulas:

Rx = (inOctets * 8) / interval * maxBaseRate

Tx = (outOctets * 8) / interval * maxBaseRate

The interval is defined in seconds. The maxBaseRate is defined by raw bits per second in one direction for the Ethernet port (that is,1 Gbps). The maxBaseRate for ASAP cards is shown in Table 12-7 on page 12-16.

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

12.6.2.6 ASAP Card POS Ports History Window

The Ethernet POS Ports History window lists past Ethernet POS Ports statistics for the previous time intervals. The History window displays the statistics for each port for the number of previous time intervals as shown in Table 12-8. The listed parameters are defined in Table 12-9 on page 12-16.

CHAPTER 13

SNMP

This chapter explains Simple Network Management Protocol (SNMP) as implemented by the Cisco ONS 15600.

For SNMP setup information, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- 13.1 SNMP Overview, page 13-1
- 13.2 Basic SNMP Components, page 13-2
- 13.3 SNMP External Interface Requirement, page 13-4
- 13.4 SNMP Version Support, page 13-4
- 13.5 SNMP Message Types, page 13-4
- 13.6 SNMP Management Information Bases, page 13-5
- 13.7 SNMP Trap Content, page 13-6
- 13.8 Proxy Over Firewalls, page 13-11

13.1 SNMP Overview

SNMP is an application-layer communication protocol that allows ONS 15600 network devices to exchange management information among these systems and with other devices outside the network. Through SNMP, network administrators can manage network performance, find and solve network problems, and plan network growth. Up to 10 SNMP trap destinations and five concurrent CTC user sessions are allowed per node.

The ONS 15600 uses SNMP for asynchronous event notification to a network management system (NMS). ONS SNMP implementation uses standard Internet Engineering Task Force (IETF) management information bases (MIBs) to convey node-level inventory, fault, and performance management information for generic read-only management of SONET technologies. SNMP allows a generic SNMP manager such as HP OpenView Network Node Manager (NNM) or Open Systems Interconnection (OSI) NetExpert to be utilized for limited management functions.

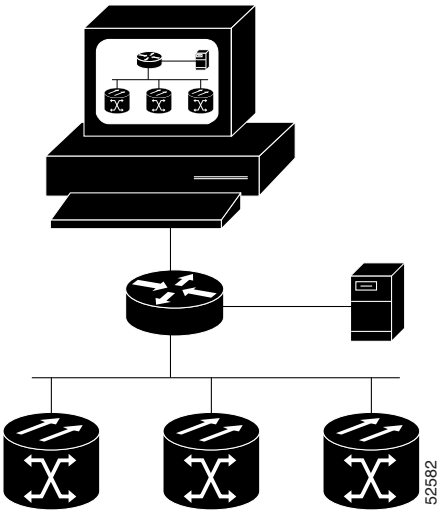
The Cisco ONS 15600 supports SNMP Version 1 (SNMPv1) and SNMP Version 2c (SNMPv2c). These versions share many features, but SNMPv2c includes additional protocol operations and 64-bit performance monitoring support. This chapter describes both versions and gives SNMP configuration parameters for the ONS 15600.

Note It is recommended that the SNMP Manager timeout value be set to 60 seconds. Under certain conditions, if this value is lower than the recommended time, the TCC card can reset. However, the response time depends on various parameters such as object being queried, complexity, and number of hops in the node, etc.

Note The CERENT-MSDWDM-MIB.mib, CERENT-FC-MIB.mib, and CERENT-GENERIC-PM-MIB.mib in the CiscoV2 directory support 64-bit performance monitoring counters. The SNMPv1 MIB in the CiscoV1 directory does not contain 64-bit performance monitoring counters, but supports the lower and higher word values of the corresponding 64-bit counter. The other MIB files in the CiscoV1 and CiscoV2 directories are identical in content and differ only in format.

Figure 13-1 illustrates the basic layout idea of an SNMP-managed network.

Figure 13-1 Basic Network Managed by SNMP

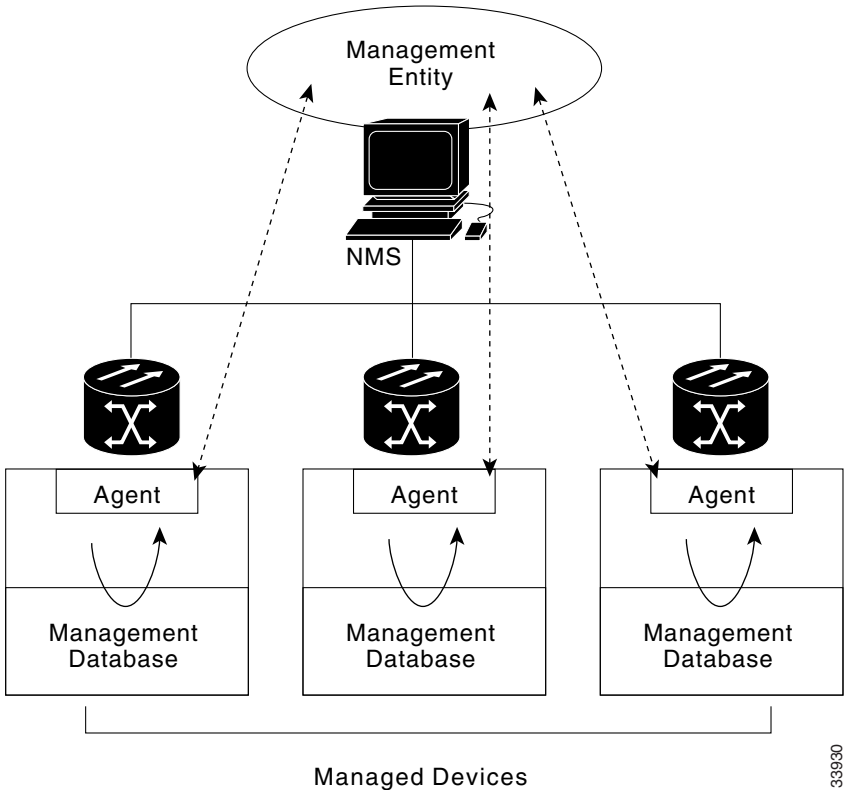


13.2 Basic SNMP Components

In general terms, an SNMP-managed network consists of a management system, agents, and managed devices.

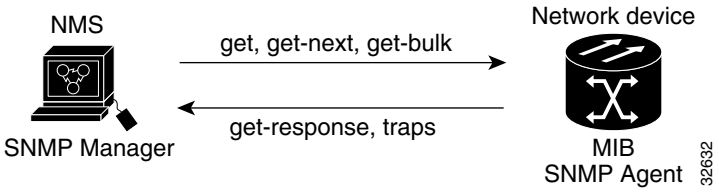
A management system such as HP OpenView executes monitoring applications and controls managed devices. Management systems execute most of the management processes and provide the bulk of memory resources used for network management. A network might be managed by one or more management systems. Figure 13-2 illustrates the relationship between the network manager, SNMP agent, and the managed devices.

Figure 13-2 Example of the Primary SNMP Components



An agent (such as SNMP) residing on each managed device translates local management information data, such as performance information or event and error information caught in software traps, into a readable form for the management system. Figure 13-3 illustrates SNMP agent get-requests that transport data to the network management software.

Figure 13-3 Agent Gathering Data from a MIB and Sending Traps to the Manager



The SNMP agent captures data from management information bases, or MIBs, which are device parameter and network data repositories, or from error or change traps.

A managed element—such as a router, access server, switch, bridge, hub, computer host, or network element (such as an ONS 15600)—is accessed through the SNMP agent. Managed devices collect and store management information, making it available through SNMP to other management systems having the same protocol compatibility.

13.3 SNMP External Interface Requirement

Since all SNMP requests come from a third-party application, the only external interface requirement is that a third-part SNMP client application can upload RFC 3273 SNMP MIB variables in the etherStatsHighCapacityTable, etherHistoryHighCapacityTable, or mediaIndependentTable.

13.4 SNMP Version Support

The ONS 15600 supports SNMPv1 and SNMPv2c traps and get requests. The ONS 15600 SNMP MIBs define alarms, traps, and status. Through SNMP, NMS applications can query a management agent for data from functional entities such as Ethernet switches and SONET multiplexers using a supported MIB.

Note ONS 15600 MIB files in the CiscoV1 and CiscoV2 directories are almost identical in content except for the difference in 64-bit performance monitoring features. The CiscoV2 directory contains three MIBs with 64-bit performance monitoring counters: CERENT-MSDWDM-MIB.mib, CERENT-FC-MIB.mib, and CERENT-GENERIC-PM-MIB.mib. The CiscoV1 directory does not contain any 64-bit counters, but it does support the lower and higher word values used in 64-bit counters. The two directories also have somewhat different formats.

13.5 SNMP Message Types

The ONS 15600 SNMP agent communicates with an SNMP management application using SNMP messages. Table 13-1 describes these messages.

Table 13-1 ONS 15600 SNMP Message Types

Operation	Description
get-request	Retrieves a value from a specific variable.
get-next-request	Retrieves the value following the named variable; this operation is often used to retrieve variables from within a table. With this operation, an SNMP manager does not need to know the exact variable name. The SNMP manager searches sequentially to find the needed variable from within the MIB.
get-response	Replies to a get-request, get-next-request, get-bulk-request, or set-request sent by an NMS.
get-bulk-request	Fills the get-response with up to the max-repetition number of get-next interactions, similar to a get-next-request.
set-request	Provides remote network monitoring (RMON) MIB.
trap	Indicates that an event has occurred. An unsolicited message is sent by an SNMP agent to an SNMP manager.

13.6 SNMP Management Information Bases

This section contains the following information:

- 13.6.1 IETF-Standard MIBs for ONS 15600, page 13-5 lists IETF-standard MIBs that are implemented in the ONS 15600 and shows their compilation order.
- 13.6.2 Proprietary ONS 15600 MIBs, page 13-6 lists proprietary MIBs for the ONS 15600 and shows their compilation order.

13.6.1 IETF-Standard MIBs for ONS 15600

Table 13-2 lists the IETF-standard MIBs implemented in the ONS 15600 SNMP agents.

First compile the MIBs in Table 13-2. Next, compile the MIBs in the order given in Table 13-3.

Caution If you do not compile MIBs in the correct order, one or more might not compile correctly.

Table 13-2 IETF Standard MIBs Implemented in the ONS 15600 System

RFC[1] Number	Module Name	Title/Comments
—	IANAifType-MIB.mib	Internet Assigned Numbers Authority (IANA) ifType
1213	RFC1213-MIB-rfc1213.mib	Management Information Base for Network
1907	SNMPV2-MIB-rfc1907.mib	Management of TCP/IP-based Internet: MIB-II Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)
1253	RFC1253-MIB-rfc1253.mib	OSPF Version 2 Management Information Base
1493	BRIDGE-MIB-rfc1493.mib	Definitions of Managed Objects for Bridges (This defines MIB objects for managing MAC bridges based on the IEEE 802.1D-1990 standard between Local Area Network [LAN] segments.)
2819	RMON-MIB-rfc2819.mib	Remote Network Monitoring Management Information Base
2737	ENTITY-MIB-rfc2737.mib	Entity MIB (Version 2)
2233	IF-MIB-rfc2233.mib	Interfaces Group MIB using SNMPv2
2358	EtherLike-MIB-rfc2358.mib	Definitions of Managed Objects for the Ethernet-like Interface Types
2493	PerfHist-TC-MIB-rfc2493.mib	(Not applicable to the ONS 15600) Textual Conventions for MIB Modules Using Performance History Based on 15 Minute Intervals
2495	DS1-MIB-rfc2495.mib	Not applicable to the ONS 15600
2496	DS3-MIB-rfc2496.mib	Not applicable to the ONS 15600
2558	SONET-MIB-rfc2558.mib	Definitions of Managed Objects for the SONET/SDH Interface Type

Table 13-2 IETF Standard MIBs Implemented in the ONS 15600 System (continued)

RFC[1] Number	Module Name	Title/Comments
2674	P-BRIDGE-MIB-rfc2674.mib Q-BRIDGE-MIB-rfc2674.mib	Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering and Virtual LAN Extensions
3273	HC-RMON-MIB	The MIB module for managing RMON device implementations, augmenting the original RMON MIB as specified in RFC 2819 and RFC 1513, and RMON-2 MIB as specified in RFC 2021

1. RFC = Request for Comment

13.6.2 Proprietary ONS 15600 MIBs

Each ONS 15600 is shipped with a software CD containing applicable proprietary MIBs. The MIBs in Table 13-3 lists the proprietary MIBs for the ONS 15600.

Table 13-3 ONS 15600 Proprietary MIBs

MIB Number	Module Name
1	CERENT-GLOBAL-REGISTRY.mib
2	CERENT-TC.mib
3	CERENT-600.mib
4	CERENT-GENERIC.mib

Note If you cannot compile the proprietary MIBs correctly, log into the Cisco Technical Assistance Center (TAC) at http://www.cisco.com/techsupport or call Cisco TAC (800) 553-2447.

13.7 SNMP Trap Content

The ONS 15600 generates all alarms and events, such as raises and clears, as SNMP traps. These contain the following information:

- Object IDs that uniquely identify each event with information about the generating entity (the slot or port; synchronous transport signal [STS] and Virtual Tributary [VT], or bidirectional line switched ring [BLSR]).
- Severity and service effect of the alarm (Critical [CR], Major [MJ], Minor [MN], or event; Service-Affecting [SA] or Non Service Affecting [NSA]).
- Date and time stamp showing when the alarm occurred.

13.7.1 Generic and IETF Traps

Table 13-4 contains information about the generic threshold and performance monitoring MIBs that can be used to monitor any network element (NE) contained in the network. The ONS 15600 supports the generic IETF traps listed in Table 13-4.

Table 13-4 ONS 15600 Generic Traps

Trap	From RFC No. MIB	Description
coldStart	RFC1213-MIB	Agent up, cold start.
warmStart	RFC1213-MIB	Agent up, warm start.
entConfigChange	RFC2037/ ENTITY-MIB	The entLastChangeTime value has changed.

13.7.2 Variable Trap Bindings

Each SNMP trap contains variable bindings that are used to create the MIB tables. Variable bindings for the ONS 15600 are listed in Table 13-5. For each group (such as Group A), all raps within the group are associated with all of its variable bindings.

Table 13-5 15600 SNMPv2 Trap Variable Bindings

Group	Associated Trap Name(s)	(Variable Binding Number)	SNMPv2 Variable Bindings	Description
A	dsx1LineStatusChange (from RFC 2495, not applicable to ONS 15600 but applicable to other platforms)	(1)	dsx1LineStatus	This variable indicates the line status of the interface. It contains loopback, failure, received alarm and transmitted alarm information.
		(2)	dsx1LineStatusLastChange	The value of MIB II's sysUpTime object at the time this DS1 entered its current line status state. If the current state was entered prior to the last proxy-agent re-initialization, the value of this object is zero.
		(3)	cerentGenericNodeTime	The time that an event occurred.
		(4)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor (MN), Major (MJ), and Critical (CR). Service-affecting statuses are Service-Affecting (SA) and Non-Service Affecting (NSA).
		(5)	snmpTrapAddress	The address of the SNMP trap.

Table 13-5 15600 SNMPv2 Trap Variable Bindings (continued)

Group	Associated Trap Name(s)	(Variable Binding Number)	SNMPv2 Variable Bindings	Description
B	dsx3LineStatusChange (from RFC 2496, not applicable to ONS 15600 but applicable to other platforms)	(1)	dsx3LineStatus	This variable indicates the line status of the interface. It contains loopback state information and failure state information.
		(2)	dsx3LineStatusLastChange	The value of MIB II's sysUpTime object at the time this DS3/E3 entered its current line status state. If the current state was entered prior to the last reinitialization of the proxy-agent, then the value is zero.
		(3)	cerentGenericNodeTime	The time that an event occurred.
		(4)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor, Major, and Critical. Service-affecting statuses are Service-Affecting and Non-Service Affecting.
		(5)	snmpTrapAddress	The address of the SNMP trap.
C	coldStart (from RFC 1907)	(1)	cerentGenericNodeTime	The time that an event occurred.
	warmStart (from RFC 1907)	(2)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor (MN), Major (MJ), and Critical (CR). Service-affecting statuses are Service-Affecting (SA) and Non-Service Affecting (NSA).
	newRoot (from RFC)	(3)	snmpTrapAddress	The address of the SNMP trap (not supported for ONS 15600).
	topologyChange (from RFC)	—	—	(Not supported for ONS 15600)
	entConfigChange (from RFC 2737)	—	—	—
	authenticationFailure (from RFC 1907)	—	—	—

Table 13-5 15600 SNMPv2 Trap Variable Bindings (continued)

Group	Associated Trap Name(s)	(Variable Binding Number)	SNMPv2 Variable Bindings	Description
D	failureDetectedExternal ToTheNE (from CERENT-600-mib)	(1)	cerentGenericNodeTime	The time that an event occurred.
		(2)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor (MN), Major (MJ), and Critical (CR). Service-affecting statuses are Service-Affecting (SA) and Non-Service Affecting (NSA).
		(3)	cerentGenericAlarmObject Type	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerentGenericAlarmObject Index	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerentGenericAlarmSlot Number	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerentGenericAlarmPort Number	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerentGenericAlarmLine Number	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
		(8)	cerentGenericAlarmObject Name	The TL1-style user-visible name that uniquely identifies an object in the system.
		(9)	cerentGenericAlarm AdditionalInfo	Additional information for the alarm object. In the current version of the MIB, this object contains provisioned description for alarms that are external to the NE. If there is no additional information, the value is zero.
		(10)	snmpTrapAddress	The address of the SNMP trap.

Table 13-5 15600 SNMPv2 Trap Variable Bindings (continued)

Group	Associated Trap Name(s)	(Variable Binding Number)	SNMPv2 Variable Bindings	Description
E	performanceMonitorThresholdCrossingAlert (from CERENT-600-mib)	(1)	cerentGenericNodeTime	The time that an event occurred.
		(2)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor (MN), Major (MJ), and Critical (CR). Service-affecting statuses are Service-Affecting (SA) and Non-Service Affecting (NSA).
		(3)	cerentGenericAlarmObjectType	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerentGenericAlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerentGenericAlarmSlotNumber	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerentGenericAlarmPortNumber	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerentGenericAlarmLineNumber	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
		(8)	cerentGenericAlarmObjectName	The TL1-style user-visible name that uniquely identifies an object in the system.
		(9)	cerentGenericThresholdMonitorType	This object indicates the type of metric being monitored.
		(10)	cerentGenericThresholdLocation	Indicates whether the event occurred at the near or far end.
		(11)	cerentGenericThresholdPeriod	Indicates the sampling interval period.
		(12)	cerentGenericThresholdSetValue	The value of this object is the threshold provisioned by the NMS.
		(13)	cerentGenericThresholdCurrentValue	—
		(14)	cerentGenericThresholdDetectType	—
		(15)	snmpTrapAddress	The address of the SNMP trap.

Table 13-5 15600 SNMPv2 Trap Variable Bindings (continued)

Group	Associated Trap Name(s)	(Variable Binding Number)	SNMPv2 Variable Bindings	Description
F	All other traps (from CERENT-600-MIB) not listed above	(1)	cerentGenericNodeTime	The time that an event occurred.
		(2)	cerentGenericAlarmState	The alarm severity and service-affecting status. Severities are Minor (MN), Major (MJ), and Critical (CR). Service-affecting statuses are Service-Affecting (SA) and Non-Service Affecting (NSA).
		(3)	cerentGenericAlarmObject Type	The entity that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
		(4)	cerentGenericAlarmObject Index	Every alarm is raised by an object entry in a specific table. This variable is the index of objects in each table; if the alarm is interface-related, this is the index of the interface in the interface table.
		(5)	cerentGenericAalrmSlot Number	The slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
		(6)	cerentGenericAlarmPort Number	The port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
		(7)	cerentGenericAlarmLine Number	The object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
		(8)	cerentGenericAlarmObject Name	The TL1-style user-visible name that uniquely identifies an object in the system.
		(9)	snmpTrapAddress	The address of the SNMP trap.

13.8 Proxy Over Firewalls

SNMP and NMS applications have traditionally been unable to cross firewalls used for isolating security risks inside or outside networks.CTC enables network operations centers (NOCs) to access performance monitoring data such as RMON statistics or autonomous messages across firewalls by using an SNMP proxy element installed on a firewall.

The application-level proxy transports SNMP protocol data units (PDU) between the NMS and NEs, allowing requests and responses between the NMS and NEs and forwarding NE autonomous messages to the NMS. The proxy agent requires little provisioning at the NOC and no additional provisioning at the NEs.

The firewall proxy is intended for use in a gateway network element-end network element (GNE-ENE) topology with many NEs through a single NE gateway. Up to 64 SNMP requests (such as get, getnext, or getbulk) are supported at any time behind single or multiple firewalls. The proxy interoperates with common NMS such as HP OpenView.

For security reasons, the SNMP proxy feature must be enabled at all receiving and transmitting NEs to function. For instructions to do this, refer to the *Cisco ONS 15600 Procedure Guide*.

13.8.1 Remote Monitoring

The ONS 15600 incorporates RMON to allow network operators to monitor Ethernet facility performance and events. Software R7.0 and later provide remote data communications channel (DCC) monitoring using 64-bit RMON over the DCC to gather historical and statistical Ethernet data. In general, ONS 15600 system RMON is based on the IETF-standard MIB RFC 2819 and includes the following five groups from the standard MIB: Ethernet Statistics, History Control, Ethernet History, Alarm, and Event.

13.8.2 64-Bit RMON Monitoring over DCC

The ONS 15600 DCC is implemented over the IP protocol, which is not compatible with Ethernet. The system monitors Ethernet equipment history and statistics using RMON. RMON DCC monitoring (for both IP and Ethernet) is also supported; it monitors the health of remote DCC connections.

RMON DCC contains two MIBs for DCC interfaces. They are:

- cMediaIndependentTable—Standard, RFC 3273; the proprietary extension of the HC-RMON MIB used for reporting statistics
- cMediaIndependentHistoryTable—Proprietary MIB used to support history

13.8.2.1 Row Creation in MediaIndependentTable

The mediaIndependentTable is created automatically when the Ethernet facility is created on the ONS 15600 ASAP card.

13.8.2.2 Row Creation in cMediaIndependentHistoryControlTable

SNMP row creation and deletion for the cMediaIndependentHistoryControlTable follows the same processes as for the MediaIndependentTable; only the variables differ.

In order to create a row, the SetRequest PDU should contain the following:

- cMediaIndependentHistoryControlDataSource and its desired value
- cMediaIndependentHistoryControlOwner and its desired value
- cMediaIndependentHistoryControlStatus with a value of createRequest (2)

13.8.3 HC-RMON-MIB Support

For the ONS 15600, the implementation of the high-capacity remote monitoring information base (HC-RMON-MIB, or RFC 3273) enables 64-bit support of existing RMON tables. This support is provided with the etherStatsHighCapacityTable and the etherHistoryHighCapacityTable. An additional table, the mediaIndependentTable, and an additional object, hcRMONCapabilities, are also added for this support. All of these elements are accessible by any third-party SNMP client having RFC 3273 support.

13.8.4 Ethernet Statistics RMON Group

The Ethernet Statistics group contains the basic statistics monitored for each subnetwork in a single table called the etherStatsTable.

13.8.4.1 Row Creation in etherStatsTable

The SetRequest PDU for creating a row in this table should contain all the values needed to activate a row in a single set operation, and an assigned status variable to createRequest. The SetRequest PDU object ID (OID) entries must all carry an instance value, or type OID, of 0.

In order to create a row, the SetRequest PDU should contain the following:

- The etherStatsDataSource and its desired value
- The etherStatsOwner and its desired value (size of this value is limited to 32 characters)
- The etherStatsStatus with a value of createRequest (2)

The etherStatsTable creates a row if the SetRequest PDU is valid according to the above rules. When the row is created, the SNMP agent decides the value of etherStatsIndex. This value is not sequentially allotted or contiguously numbered. It changes when an Ethernet interface is added or deleted. The newly created row will have etherStatsStatus value of valid (1).

If the etherStatsTable row already exists, or if the SetRequest PDU values are insufficient or do not make sense, the SNMP agent returns an error code.

Note EtherStatsTable entries are not preserved if the SNMP agent is restarted.

13.8.4.2 Get Requests and GetNext Requests

Get requests and getNext requests for the etherStatsMulticastPkts and etherStatsBroadcastPkts columns return a value of zero because the variables are not supported by ONS 15600 Ethernet facilities.

13.8.4.3 Row Deletion in etherStatsTable

To delete a row in the etherStatsTable, the SetRequest PDU should contain an etherStatsStatus value of 4 (invalid). The OID marks the row for deletion. If required, a deleted row can be recreated.

13.8.5 History Control RMON Group

The History Control group defines sampling functions for one or more monitor interfaces in the historyControlTable. The values in this table, as specified in RFC 2819, are derived from the historyControlTable and etherHistoryTable.

13.8.5.1 History Control Table

The RMON is sampled at one of four possible intervals. Each interval, or period, contains specific history values (also called buckets). Table 13-6 lists the four sampling periods and corresponding buckets.

The historyControlTable maximum row size is determined by multiplying the number of ports on a card by the number of sampling periods. For example, an ONS 15600 E100 card contains 24 ports, which multiplied by periods allows 96 rows in the table. An E1000 card contains 14 ports, which multiplied by four periods allows 56 table rows.

Table 13-6 RMON History Control Periods and History Categories

Sampling Periods (historyControlValue Variable)	Total Values, or Buckets (historyControl Variable)
15 minutes	32
24 hours	7
1 minute	60
60 minutes	24

13.8.5.2 Row Creation in historyControlTable

The etherStats table and historyControl table are automatically created when the Ethernet facility is created. History size is based upon the default history bucket located in Table 13-6.

13.8.5.3 Get Requests and GetNext Requests

These PDUs are not restricted.

13.8.5.4 Row Deletion in historyControl Table

To delete a row from the table, the SetRequest PDU should contain a historyControlStatus value of 4 (invalid). A deleted row can be recreated.

13.8.5.5 Ethernet History RMON Group

The ONS 15600 implements the etherHistoryTable as defined in RFC 2819. The group is created within the bounds of the historyControlTable and does not deviate from the RFC in its design.

13.8.5.6 64-Bit etherHistoryHighCapacityTable

64-bit Ethernet history for the HC-RMON-MIB is implemented in the etherHistoryHighCapacityTable, which is an extension of the etherHistoryTable. The etherHistoryHighCapacityTable adds four columns for 64-bit performance monitoring data. These two tables have a one-to-one relationship. Adding or deleting a row in one table will effect the same change in the other.

13.8.5.7 Alarm RMON Group

The Alarm group consists of the alarmTable, which periodically compares sampled values with configured thresholds and raises an event if a threshold is crossed. This group requires the implementation of the event group, which follows this section.

13.8.5.8 Alarm Table

The NMS uses the alarmTable to determine and provision network performance alarmable thresholds.

13.8.5.9 Get Requests and GetNext Requests

These PDUs are not restricted.

13.8.5.10 Row Deletion in alarmTable

To delete a row from the table, the SetRequest PDU should contain an alarmStatus value of 4 (invalid). A deleted row can be recreated. Entries in this table are preserved if the SNMP agent is restarted.

13.8.5.11 Event RMON Group

The Event group controls event generation and notification. It consists of two tables: the eventTable, which is a read-only list of events to be generated, and the logTable, which is a writable set of data describing a logged event. The ONS 15600 implements the logTable as specified in RFC 2819.

13.8.5.12 Event Table

The eventTable is read-only and unprovisionable. The table contains one row for rising alarms and another for falling ones. This table has the following restrictions:

- The eventType is always “log-and-trap (4)”.
- The eventCommunity value is always a zero-length string, indicating that this event causes the trap to be despatched to all provisioned destinations.
- The eventOwner column value is always “monitor.”
- The eventStatus column value is always “valid(1)”.

13.8.5.13 Log Table

The logTable is implemented exactly as specified in RFC 2819. The logTable is based upon data that is locally cached in a controller card. If there is a controller card protection switch, the existing logTable is cleared and a new one is started on the newly active controller card. The table contains as many rows as provided by the alarm controller.

Hardware Specifications

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This appendix provides detailed shelf assembly hardware specifications for the Cisco ONS 15600. It includes the following sections:

- A.1 Shelf Specifications, page A-1
- A.2 Card Specifications, page A-5
- A.3 SFP/XFP Specifications, page A-12

A.1 Shelf Specifications

This section provides bandwidth specifications; slot assignments; lists of cards and topologies; shelf dimensions; Cisco Transport Controller (CTC) specifications; the LAN, TL1, modem, and alarm interface specifications; and timing, database, environmental, and power specifications.

A.1.1 Bandwidth

The ONS 15600 has the following bandwidth specifications:

- Total bandwidth: 320 Gbps
- Optical bandwidth: 40 Gbps per slot

A.1.2 Slot Assignments

The ONS 15600 has the following slot assignments:

- Total card slots: 14
- Optical cards: Slots 1 to 4, 11 to 14
- Timing and Shelf Controller (TSC): Slots 5, 10

- Single Shelf Cross Connect (SSXC): Slots 6/7, 8/9

A.1.3 Cards

The ONS 15600 has the following cards:

- TSC
- SSXC
- ASAP
- OC48/STM16 LR16 1550
- OC48/STM16 SR16 1310
- OC192/STM64 LR4 1550
- OC192/STM64 SR4 1310

A.1.4 Configurations

The ONS 15600 has the following configurations:

- 1+1 automatic protections switching (APS) for point-to-point and linear configurations
- Two-fiber path protection
- Path-protected mesh network (PPMN)
- Two-fiber bidirectional line switched ring (BLSR)
- Four-fiber bidirectional line switched ring (BLSR)
- Unprotected

A.1.5 Dimensions

The ONS 15600 has the following dimensions:

- Height: 83.9 inches (2130 mm)
- Width: 23.6 inches (600 mm)
- Depth: 23.6 inches (600 mm)
- Weight: 500 lb (226.8 kg) (without cards)

A.1.6 Cisco Transport Controller

CTC has the following specifications:

- 10/100BaseT
- TSC access: RJ-45 connector
- Backplane access: RJ-45 connector

A.1.7 External LAN Interface

The external LAN interface has the following specifications:

- 10/100BaseT Ethernet
- Backplane access: RJ-45 connector

A.1.8 TL1 Craft Interface

The craft interface has the following specifications:

- Speed: 9600 bps
- Backplane (CAP) access: EIA/TIA-232 DB-9 type connector

A.1.9 Modem Interface

The modem interface has the following specifications:

- Hardware flow control
- Backplane (CAP) access: EIA/TIA-232 DB-9 type connector

A.1.10 Alarm Interface

The alarm interface has the following specifications:

- Visual: Critical, Major, Minor, Remote
- Audible: Critical, Major, Minor, Remote
- Alarm contacts: 0.045 mm, –48 VDC, 50 mA
- Backplane (CAP) access: Alarm pin fields

A.1.11 BITS Interface

The building integrated timing supply (BITS) interface has the following specifications:

- 2 DS-1 BITS inputs
- 2 derived OC-N outputs

A.1.12 System Timing

The ONS 15600 has the following system timing specifications:

- Holdover stability: Stratum 3E per Telcordia GR-253-CORE
- Free running accuracy: +/– 4.6 ppm
- Reference: External BITS, line, internal

A.1.13 Database Storage

The ONS 15600 has the following database storage specifications:

- Nonvolatile memory: 512 MB, IDE FLASH memory

A.1.14 Environmental Specifications

The ONS 15600 has the following environmental specifications:

- Operating temperature: 23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
- Operating humidity: 5 to 95%, noncondensing

A.1.15 Power Specifications

The ONS 15600 has the following power specifications:

- Input voltage: –48 VDC
- Input current: 80 A per channel (six channels provided)
- Power terminals: Lug

Table A-1 lists the power requirements for each card.

Table A-1 Power Requirements for Individual Cards

Card Type	Card Name	Watts
Control Cards	TSC	58
	SSXC	165
Optical Cards	OC48/STM16 LR16 1550	170
	OC48/STM16 SR16 1310	180
	OC192/STM64 LR4 1550	180
	OC192/STM64 SR4 1310	165
Multifunction Cards	ASAP	170

Table A-2 lists the power requirements for an individual fan in the fan-tray assembly.

Table A-2 Power Requirements for Individual Fans

Condition	Watts	Amps	BTU/Hr.
Min. at 48 V (ambient temperature less than 25 degrees Celsius (77 degrees Fahrenheit)	12	0.25	41
Max at 48 V (ambient temperature greater than 25 degrees Celsius (77 degrees Fahrenheit)	46	0.95	157

A.2 Card Specifications

This section provides specifications for the TSC, SSXC, OC48/STM16 LR/LH 16 Port 1550, OC48/STM16 SR/SH 16 Port 1310, OC192/STM64 LR/LH 4 Port 1550, OC192/STM64 SR/SH 4 Port 1310, ASAP, and Filler cards.

A.2.1 TSC Card Specifications

Table A-3 shows the TSC card specifications.

Table A-3 TSC Card Specifications

Specification Type	Description
CTC software	Interface: 10/100BaseT LAN Backplane (CAP) access: RJ-45
TL1 craft interface	Speed: 10/100BaseT LAN Front panel access: RJ-45 type connector Backplane access: RJ-45 and EIA/TIA-232 DB-9 type connector
Synchronization	Stratum 3E, per Telcordia GR-1244 Free running access: accuracy 4.6 ppm Holdover stability: 3.7 x10^{-7} ppm/day including temperature (< 255 slips in first 24 hours) Reference: External BITS, line, internal
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.10 in. (28 mm) Depth: 18.31 in. (465 mm) Card weight: 4.0 lb (1.81 kg)
Compliance	When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950

A.2.2 SSXC Specifications

Table A-4 shows the SSXC card specifications.

Table A-4 SSXC Card Specifications

Specification Type	Description
Cross-connect	Connection setup time: 7 microseconds Latency: 0.5 microseconds
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 2.36 in. (60 mm) Depth: 18.31 in. (465 mm) Card weight: 5.0 lb (2.27 kg)
Compliance	When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950

A.2.3 OC48/STM16 LR/LH 16 Port 1550 Specifications

Table A-5 shows the OC48/STM16 LR/LH 16 Port 1550 card specifications.

Table A-5 OC48/STM16 LR/LH 16 Port 1550 Card Specifications

Specification Type	Description
Line	Bit rate: 2.49 Gbps Code: Scrambled nonreturn to zero (NRZ) Fiber: 1550 nm single-mode Loopback mode: Facility Connectors: OGI Compliance: SONET Telcordia GR-253
Transmitter	Max. transmitter output power: +3 dBm Min. transmitter output power: –2 dBm Center wavelength: 1500 nm to 1580 nm Nominal wavelength: 1550 nm Transmitter: Distributed feedback (DFB) laser **Note** The Cisco Transport Controller (CTC) Maintenance > Transceiver tab shows the optical power transmitted (OPT) levels. CTC might show OPT levels at 1 dBm more or less than the actual card OPT level.

Table A-5 OC48/STM16 LR/LH 16 Port 1550 Card Specifications (continued)

Specification Type	Description
Receiver	Max. receiver level: –9 dBm Min. receiver level: –28 dBm Receiver: InGaAs Avalanche Photo Diode (APD) photo detector Link loss budget: 26 dB minimum, with 1 dBm dispersion penalty
Loopback mode	Facility (Line) **Note** You must use a 19 to 24 dBm (15 to 20 dBm is recommended) fiber attenuator when connecting a fiber loopback to an OC48/STM16 LR/LH 16 Port 1550 card. Never connect a direct fiber loopback.
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.50 in. (38 mm) Depth: 18.31 in. (465 mm) Card weight: 5.0 lb (2.27 kg)
Compliance	SONET Telcordia GR-253 When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950 Eye safety compliance: Class 1 (21 CFR 1040.10 and 1040.11) and Class 1 (IEC 60825) laser products

A.2.4 OC48/STM16 SR/SH 16 Port 1310 Specifications

Table A-6 shows the OC48/STM16 SR/SH 16 Port 1310 card specifications.

Table A-6 OC48/STM16 SR/SH 16 Port 1310 Card Specifications

Specification Type	Description
Line	Bit rate: 2.49 Gbps Code: Scrambled NRZ Fiber: 1310 nm single-mode Loopback mode: Facility Connectors: OGI Compliance: SONET Telcordia GR-253
Transmitter	Max. transmitter output power: –3 dBm Min. transmitter output power: –10 dBm Center wavelength: 1266 nm to 1360 nm Nominal wavelength: 1310 nm Transmitter: Fabry Perot laser **Note** The CTC Maintenance > Transceiver tab shows the OPT levels. CTC might show OPT levels at 1 dBm more or less than the actual card OPT level.
Receiver	Max. receiver level: –3 dBm Min. receiver level: –18 dBm Receiver: Positive-intrinsic-negative (PIN) diode Link loss budget: 8 dBm min., with 1 dBm dispersion penalty
Loopback mode	Facility (Line) **Note** You must use a 3-dBm fiber attenuator when connecting a fiber loopback to an OC48/STM16 SR/SH 16 port 1310 card. Never connect a direct fiber loopback.
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.50 in. (38 mm) Depth: 18.31 in. (465 mm) Card weight: 5.0 lb (2.27 kg)
Compliance	SONET Telcordia GR-253 When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950 Eye safety compliance: Class 1 (21 CFR 1040.10 and 1040.11) and Class 1 (IEC 60825) laser products

A.2.5 OC192/STM64 LR/LH 4 Port 1550 Specifications

Table A-7 shows the OC192/STM64 LR/LH 4 Port 1550 card specifications.

Table A-7 OC192/STM64 LR/LH 4 Port 1550 Card Specifications

Specification Type	Description
Line	Bit rate: 9.96 Gbps Code: Scrambled NRZ Fiber: 1550 nm Single mode
Transmitter	Max. transmitter output power: +7 dBm Min. transmitter output power: +4 dBm Center wavelength: 1530 nm to 1565 nm Nominal wavelength: 1550 nm Transmitter: Lithium Niobate (LN) external modulator transmitter
Receiver	Max. receiver level: –9 dBm Min. receiver level: –22 dBm Receiver: APD/TIA Link loss budget: 24 dB min., with no dispersion or 22 dB optical path loss at BER = 1^{-12} including dispersion
Loopback mode	Payload **Note** You must use a 19 to 24 dB (15 to 20 is recommended) fiber attenuator when connecting a fiber loopback to an OC192/STM64 LR/LH 4 Port 1550 card. Never connect a direct fiber loopback.
Connectors	OGI
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.50 in. (38 mm) Depth: 18.31 in. (465 mm) Card weight: 12.0 lb (5.44 kg)
Compliance	SONET Telcordia GR-253 When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950 Eye safety compliance: Class 1 (21 CFR 1040.10 and 1040.11) and Class 1 (IEC 60825) laser products

A.2.6 OC192/STM64 SR/SH 4 Port 1310 Specifications

Table A-8 shows the OC192/STM64 SR/SH 4 Port 1310 card specifications.

Table A-8 OC192/STM64 SR/SH 4 Port 1310 Card Specifications

Specification Type	Description
Line	Bit rate: 9.96 Gbps Code: Scrambled NRZ Fiber: 1310 nm single mode
Transmitter	Max. transmitter output power: –1 dBm Min. transmitter output power: –6 dBm Center wavelength: 1290 nm to 1330 nm Nominal wavelength: 1310 nm
Receiver	Max. receiver level: –1 dBm Min. receiver level: –11 dBm Link loss budget: –5 dB min., with no dispersion or 4 dB optical path loss at BER = 1^{-12} including dispersion
Loopback mode	Payload **Note** You must use a 3-dBm fiber attenuator when connecting a fiber loopback to an OC192/STM64 SR/SH 4 Port 1310 card. Never connect a direct fiber loopback.
Connectors	OGI
Operating temperature	23 to 122 degrees Fahrenheit (–5 to +50 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.50 in. (38 mm) Depth: 18.31 in. (465 mm) Card weight: 12.0 lb (5.44 kg)
Compliance	SONET Telcordia GR-253 When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950 Eye safety compliance: Class 1 (21 CFR 1040.10 and 1040.11) and Class 1 (IEC 60825) laser products

A.2.7 ASAP Specifications

Table A-9 shows the ASAP card specifications.

Table A-9 ASAP Card Specifications

Specification Type	Description
Carrier Card (CC)	Contains slots for four pluggable ASAP I/O cards, which can be used to provide a variety of optical line interfaces. The CC provides 4 electrical STS-48 or Gigabit Ethernet signals to each ASAP I/O card (for 16 total) and 16 redundant electrical STS-48 matrix interfaces to the backplane. For SONET interfaces, the CC card provides pointer processing and overhead extraction/insertion.
4PIO Pluggable I/O card	The ASAP 4PIO module is a four-port multirate optical interface card. It has four slots for Small Form-factor Pluggable (SFP) optics. The four ports can be provisioned on a per-port basis as OC-3, OC-12, OC-48, or Gigabit Ethernet interfaces.
1PIO Pluggable I/O card	The ASAP 1PIO module is a single-port single-rate optical interface card. It has one slot for XFP optics. The port can be provisioned for one OC-192 interface.
Payloads	Nonconcatenated and/or concatenated payloads at STS-1, STS-3c, STS-6C, STS-9C, STS-12c, STS-24c, STS-48c, and STS-192c are supported. For Gigabit Ethernet interfaces, Layer 1 Ethernet transport is also implemented.
SFP support	ONS-SE-Z1: Supports OC-3 SR-1, OC-12 SR-1, OC-48 IR-1 or GE LX ONS-SI-155-L2: Supports OC-3 LR-2 ONS-SI-622-L2: Supports OC-12 LR-2 ONS-SE-2G-L2: Supports OC-48 LR-2
XFP support	ONS-XC-10G-S1: Supports OC-192 SR-1 ONS-XC-10G-L2: Supports OC-192 LR-2
Connectors	Up to 16 SFP connectors (4 per 4PIO module) or 4 XFP connectors (1 per 1PIO module), at front edge of card
Power	130 W to 180 W (maximum)
Operating temperature	23 to 131 degrees Fahrenheit (–5 to +55 degrees Celsius)
Operating humidity	5 to 95%, noncondensing
Dimensions	Height: 16.50 in. (419 mm) Width: 1.50 in. (38 mm) Depth: 18.31 in. (465 mm) Card weight: approximately 6 lb (13.22 kg)
Compliance	SONET Telcordia GR-253 When installed in a system, ONS 15600 cards comply with these safety standards: UL 60950, CSA C22.2 No. 950, EN 60950, IEC 60950 Eye safety compliance: Class 1 (21 CFR 1040.10 and 1040.11) and Class 1 (IEC 60825) laser products

A.2.8 Filler Card Specifications

Table A-10 shows the Filler card specifications.

Table A-10 Filler Card Specifications

Specification Type	Description
Dimensions	Height: 16.50 in. (419 mm)
	Width:1.50 in. (38 mm)
	Depth: 18.31 in. (465 mm)
	Card weight: 2.5 lb (1.134 kg)

A.3 SFP/XFP Specifications

Table A-11 and Table A-12 list the specifications for available SFPs and XFPs for the Cisco ONS 15600.

Table A-11 SFP Specifications (4PIO Only)

SFP Product ID	Interface	Transmitter Output Power Min/Max (dBm)	Receiver Input Power Min/Max (dBm)
ONS-SI-622-L2	OC-12, STM-4	–3.0 to 2.0	–28 to –8
ONS-SI-155-L2	OC-3, STM-1	–5.0 to 0.0	–34 to –10
ONS-SE-2G-L2	OC-48, STM-16	–2.0 to 3.0	–28 to –9
ONS-SE-Z1	OC-3/12/48, STM-1/4/16	–5.0 to 0	–23 to –3 (155.52/ 622.08 Mbps) –19 to –3 (1250 Mbps) –18 to 0 (2488.32 Mbps)

Table A-12 XFP Specifications (1PIO Only)

SFP Product ID	Interface	Transmitter Output Power Min/Max (dBm)	Receiver Input Power Min/Max (dBm)
ONS-XC-10G-S1	OC-192, STM-64	–6.0 to –1.0	–11.0 to –1.0
ONS-XC-10G-L2	OC-192, STM-64	0.0 to 4.0	–24.0 to –7.0

The OC-48/STM16 also supports 32-channel SFPs for DWDM applications that can be plugged into the four-port ASAP card 4PIO module.

Some of the parameters common across all 32 DWDM SFPs include:

- Receiver wavelength: 1260 to 1620 nm
- Minimum overload: –9 dBm
- Maximum reflectance of receiver, measured at Rs: –27 dB
- Maximum receiver power, damage threshold: +5 dBm
- Transmitter output power min/max (dBm): 0 to +4 dBm

Table A-13 lists the available DWDM SFPs.

Table A-13 ASAP Card 4PIO DWDM SFP Specifications

SFP Product ID	Interface	Wavelength[1]
ONS-SC-2G-30.3	OC-48/STM16	1530.3 nm
ONS-SC-2G-31.1	OC-48/STM16	1531.1 nm
ONS-SC-2G-31.9	OC-48/STM16	1531.9 nm
ONS-SC-2G-32.6	OC-48/STM16	1532.6 nm
ONS-SC-2G-34.2	OC-48/STM16	1534.2 nm
ONS-SC-2G-35.0	OC-48/STM16	1535.0 nm
ONS-SC-2G-35.8	OC-48/STM16	1535.8 nm
ONS-SC-2G-36.6	OC-48/STM16	1536.6 nm
ONS-SC-2G-38.1	OC-48/STM16	1538.1 nm
ONS-SC-2G-38.9	OC-48/STM16	1538.9 nm
ONS-SC-2G-39.7	OC-48/STM16	1539.7 nm
ONS-SC-2G-40.5	OC-48/STM16	1540.5 nm
ONS-SC-2G-42.1	OC-48/STM16	1542.1 nm
ONS-SC-2G-42.9	OC-48/STM16	1542.9 nm
ONS-SC-2G-43.7	OC-48/STM16	1543.7 nm
ONS-SC-2G-44.5	OC-48/STM16	1544.5 nm
ONS-SC-2G-46.1	OC-48/STM16	1546.1 nm
ONS-SC-2G-46.9	OC-48/STM16	1546.9 nm
ONS-SC-2G-47.7	OC-48/STM16	1547.7 nm
ONS-SC-2G-48.5	OC-48/STM16	1548.5 nm
ONS-SC-2G-50.1	OC-48/STM16	1550.1 nm
ONS-SC-2G-50.9	OC-48/STM16	1550.9 nm
ONS-SC-2G-51.7	OC-48/STM16	1551.7 nm
ONS-SC-2G-52.5	OC-48/STM16	1552.5 nm
ONS-SC-2G-54.1	OC-48/STM16	1554.1 nm
ONS-SC-2G-54.9	OC-48/STM16	1554.9 nm
ONS-SC-2G-55.7	OC-48/STM16	1555.7 nm
ONS-SC-2G-56.5	OC-48/STM16	1556.5 nm
ONS-SC-2G-58.1	OC-48/STM16	1558.1 nm
ONS-SC-2G-58.9	OC-48/STM16	1558.9 nm
ONS-SC-2G-59.7	OC-48/STM16	1559.7 nm
ONS-SC-2G-60.6	OC-48/STM16	1560.6 nm

1. Typical loss on a 1310-nm wavelength SMF is 0.6 dB/km.

Table A-14 describes the power and noise limited performances parameters for the OC-SC-2G series SFPs.

Table A-14 Power and Noise Limited Performances

Parameter	Power Limited Performances		Noise Limited Performances	
Input power range	–9 to –28 dBm	At BER = 10^{-12} with SONET framed PRBS23 622 Mbps – 2.0 Gbps at OSNR[1] of 20 dB, 0.1 nm bandwidth 2.0Gbps – 2.7Gbps at OSNR of 21dB, 0.1 nm bandwidth	–9 to –22 dBm	At BER = 10^{-12} with SONET framed PRBS23 At OSNR of 16 dB at 0.1 nm bandwidth.
Dispersion tolerance	–800 to 3600 dBm	622 Mbps – 2.0 Gbps Power penalty = 3 dB OSNR = 20 dB at 0.1 nm bandwidth (Noise penalty = 0 dB)	–800 to 3600 dBm	622 Mbps – 2.0 Gbps Noise penalty = 2 dB OSNR = 18 dB at 0.1 nm bandwidth (Power penalty = 0 dB)
	–800 to 2400 dBm	2.0 Gbps – 2.7 Gbps Power penalty = 3 dB OSNR = 21 dB at 0.1 nm bandwidth (Noise penalty = 0 dB)	–800 to 2400 dBm	2.0 Gbps – 2.7 Gbps Noise penalty = 3 dB OSNR = 19 dB at 0.1 nm bandwidth (Power penalty = 0 dB)

1. OSNR = optical signal-to-noise ratio

Table A-15 provides cabling specifications for the single-mode fiber (SMF) SFPs/XFPs. The ports of the listed SFPs/XFPs have LC-type connectors and the minimum cable distance for all SFPs/XFPs listed is 6.5 feet (2 m). Maximum cable distance for all SFPs/XFPs listed is 328 ft (100 m).

Table A-15 Single-Mode Fiber SFP/XFP Port Cabling Specifications

SFP Product ID	Wavelength[1]	Fiber Type	Cable Distance
ONS-SI-622-L2 Long Reach	1550 nm	9 micron SMF	80 km (49.71 mi.)
ONS-SE-2G-L2	1550 nm	9 micron SMF	80 km (49.71 mi.)
ONS-SE-Z1	1310 nm	9 micron SMF	15 km (9.3 mi.)
ONS-SI-155-L2	1550 nm	9 micron SMF	80 km (49.71 mi.)
ONS-XC-10G-S1	1310 nm	9 micron SMF	2 km (1.2 miles)
ONS-XC-10G-L2	1550 nm	9 micron SMF	80 km (49.71 miles)

1. Typical loss on a 1310-nm wavelength SMF is 0.6 dB/km.

Administrative and Service States

This appendix describes administrative and service states for Cisco ONS 15600 cards, ports, and cross-connects. For circuit state information, see Chapter 7, "Circuits and Tunnels." Entity states are based on the generic state model defined in Telcordia GR-1093-CORE, Issue 2 and ITU-T X.731. The following sections are included:

- B.1 Service States, page B-1
- B.2 Administrative States, page B-2
- B.3 Service State Transitions, page B-3

B.1 Service States

Service states include a Primary State (PST), a Primary State Qualifier (PSTQ), and one or more Secondary States (SST). Table B-1 lists the service state PSTs and PSTQs supported by the ONS 15600.

Table B-1 ONS 15600 Service State Primary States and Primary State Qualifiers

Primary State, Primary State Qualifier	Definition
IS-NR	(In-Service and Normal) The entity is fully operational and will perform as provisioned.
OOS-AU	(Out-of-Service and Autonomous) The entity is not operational because of an autonomous event.
OOS-AUMA	(Out-of-Service and Autonomous Management) The entity is not operational because of an autonomous event and has also been manually removed from service.
OOS-MA	(Out-of-Service and Management) The entity has been manually removed from service.

Table B-2 defines the SSTs supported by the ONS 15600.

Table B-2 ONS 15600 Secondary States

Secondary State	Definition
AINS	(Automatic In-Service) The entity is delayed before transitioning to the IS-NR service state. The transition to IS-NR depends on correction of conditions, or on a soak timer. Alarm reporting is suppressed, but traffic is carried. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
DSBLD	(Disabled) The entity was manually removed from service and does not provide its provisioned functions. All services are disrupted; the entity is unable to carry traffic.
FLT	(Fault) The entity has a raised alarm or condition.
LPBK	(Loopback) The entity is in loopback mode.
MEA	(Mismatched Equipment) An improper card is installed. For example, an installed card is not compatible with the card preprovisioning or the slot. This SST applies only to cards.
MT	(Maintenance) The entity has been manually removed from service for a maintenance activity but still performs its provisioned functions. Alarm reporting is suppressed, but traffic is carried. Raised fault conditions, whether or not their alarms are reported, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.
SWDL	(Software Download) The card is involved in a software and database download. This SST applies only to cards.
UAS	(Unassigned) The card is not provisioned in the database. This SST applies only to cards.
UEQ	(Unequipped) The card is not physically present (that is, an empty slot). This SST applies only to cards.

B.2 Administrative States

Administrative states are used to manage service states. Administrative states consist of a PST and an SST. Table B-3 lists the administrative states supported by the ONS 15600. See Table B-2 for SST definitions.

Note A change in the administrative state of an entity does not change the service state of supporting or supported entities.

Table B-3 ONS 15600 Administrative States

Administrative State (PST,SST)	Definition
IS	Puts the entity in-service.
IS,AINS	Puts the entity in automatic in-service.
OOS,DSBLD	Removes the entity from service and disables it.
OOS,MT	Removes the entity from service for maintenance.

B.3 Service State Transitions

This section describes the transition from one service state to the next for cards, ports, and cross-connects. A service state transition is based on the action performed on the entity.

Note When an entity is put in the OOS,MT administrative state, the ONS 15600 suppresses all standing alarms on that entity. All alarms and events appear on the Conditions tab. You can change this behavior for the LPBKFACILITY and LPBKTERMINAL alarms. To display these alarms on the Alarms tab, set the NODE.general.ReportLoopbackConditionsOnOOS-MTPorts to TRUE on the NE Defaults tab.

B.3.1 Card Service State Transitions

Table B-4 lists card service state transitions.

Table B-4 ONS 15600 Card Service State Transitions

Current Service State	Action	Next Service State
IS-NR	Change the administrative state to OOS,MT.	OOS-MA,MT
	Delete the card.	OOS-AUMA,UAS
	Pull the card.	OOS-AU,UEQ
	Reset the card.	OOS-AU,SWDL
	Alarm/condition is raised.	OOS-AU,FLT
OOS-AU,AINS and MEA	Pull the card.	OOS-AU,AINS & UEQ
	Delete the card.	OOS-AUMA,UAS if the card is valid OOS-AUMA,MEA & UAS if the card is invalid
OOS-AU,AINS & SWDL	Restart completed.	IS-NR
	Pull the card.	OOS-AU,AINS & UEQ
OOS-AU,AINS & UEQ	Insert a valid card.	OOS-AU,AINS & SWDL
	Insert an invalid card.	OOS-AU,AINS & MEA
	Delete the card.	OOS-AUMA,UAS & UEQ
OOS-AU,FLT	Pull the card.	OOS-AU,UEQ
	Delete the card.	OOS-AUMA,UAS
	Change the administrative state to OOS,MT.	OOS-AUMA,FLT & MT
	Reset the card.	OOS-AU,SWDL
	Alarm/condition is cleared.	IS-NR

Table B-4 ONS 15600 Card Service State Transitions (continued)

Current Service State	Action	Next Service State
OOS-AU,MEA	Pull the card.	OOS-AU,UEQ
	Delete the card.	OOS-AUMA,UAS if the card is valid OOS-AUMA,MEA & UAS if the card is invalid
	Change the administrative state to OOS,MT.	OOS-AU,MEA & MT
OOS-AU,SWDL	Restart completed.	IS-NR
	Pull the card.	OOS-AU,UEQ
OOS-AU,UEQ	Insert a valid card.	OOS-AU,SWDL
	Insert an invalid card.	OOS-AU,MEA
	Delete the card.	OOS-AUMA,UAS & UEQ
	Change the administrative state to OOS,MT.	OOS-AUMA,MT & UEQ
OOS-AUMA,FLT & MT	Pull the card.	OOS-AUMA,MT & UEQ
	Delete the card.	OOS-AUMA,UAS
	Change the administrative state to IS.	OOS-AU,FLT
	Reset the card.	OOS-AUMA,MT & SWDL
	Alarm/condition is cleared.	OOS-MA,MT
OOS-AUMA,MEA & MT	Change the administrative state to IS.	OOS-AU,MEA
	Pull the card.	OOS-AUMA,MT & UEQ
	Delete the card.	OOS-AUMA,UAS if the card is valid OOS-AUMA,MEA & UAS if the card is invalid
OOS-AUMA,MEA & UAS	Pull the card.	OOS-AUMA,UAS & UEQ
	Provision the card.	OOS-AU,MEA
OOS-AUMA,MT & SWDL	Restart completed.	OOS-MA,MT
	Pull the card.	OOS-AUMA,MT & UEQ
OOS-AUMA,MT & UEQ	Change the administrative state to IS.	OOS-AU,UEQ
	Insert a valid card.	OOS-AUMA,MT & SWDL
	Insert an invalid card.	OOS-AUMA,MEA & MT
	Delete the card.	OOS-AUMA,UAS & UEQ

Table B-4 ONS 15600 Card Service State Transitions (continued)

Current Service State	Action	Next Service State
OOS-AUMA,UAS	Pull the card.	OOS-AUMA,UAS & UEQ
	Provision an invalid card.	OOS-AU,MEA
	Provision a valid card.	OOS-AU,SWDL
OOS-AUMA,UAS & UEQ	Insert a valid card.	OOS-AU,SWDL
	Insert an invalid card.	OOS-AUMA,MEA & UAS
	Preprovision a card.	OOS-AU,AINS & UEQ
OOS-MA,MT	Change the administrative state to IS.	IS-NR
	Delete the card.	OOS-AUMA,UAS
	Pull the card.	OOS-AUMA,MT & UEQ
	Reset the card.	OOS-AUMA,MT & SWDL
	Alarm/condition is raised.	OOS-AUMA,FLT & MT

B.3.2 Port and Cross-Connect Service State Transitions

Table B-5 lists the port and cross-connect service state transitions. Port states do not impact cross-connect states with one exception. A cross-connect in the OOS-AU,AINS service state cannot transition autonomously into the IS-NR service state until the parent port is IS-NR.

Note Deleting a port or cross-connect removes the entity from the system. The deleted entity does not transition to another service state.

Table B-5 ONS 15600 Port and Cross-Connect Service State Transitions

Current Service State	Action	Next Service State
IS-NR	Put the port or cross-connect in the OOS,MT administrative state.	OOS-MA,MT
	Put the port or cross-connect in the OOS,DSBLD administrative state.	OOS-MA,DSBLD
	Put the port or cross-connect in the IS,AINS administrative state.	OOS-AU,AINS

Table B-5 ONS 15600 Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
OOS-AU,AINS	Put the port or cross-connect in the IS administrative state.	IS-NR
	Put the port or cross-connect in the OOS,MT administrative state.	OOS-MA,MT
	Put the port or cross-connect in the OOS,DSBLD.	OOS-MA,DSBLD
	Alarm/condition is raised.	OOS-AU,AINS & FLT
OOS-AU,AINS & FLT	Alarm/condition is cleared.	OOS-AU,AINS
	Put the port or cross-connect in the IS administrative state.	OOS-AU,FLT
	Put the port or cross-connect in the OOS,DSBLD administrative state.	OOS-MA,DSBLD
	Put the port or cross-connect in the OOS,MT administrative state.	OOS-AUMA,FLT & MT
OOS-AU,FLT	Alarm/condition is cleared.	IS-NR
	Put the port or cross-connect in the IS,AINS administrative state.	OOS-AU,AINS & FLT
	Put the port or cross-connect in the OOS,DSBLD administrative state.	OOS-MA,DSBLD
	Put the port or cross-connect in the OOS,MT administrative state	OOS-AUMA,FLT & MT
OOS-AUMA,FLT & LPBK & MT	Release the loopback.	OOS-AUMA,FLT & MT
	Alarm/condition is cleared.	OOS-MA,LPBK & MT
OOS-AUMA,FLT & MT	Alarm/condition is cleared.	OOS-MA,MT
	Put the port or cross-connect in the IS administrative state.	OOS-AU,FLT
	Put the port or cross-connect in the IS,AINS administrative state.	OOS-AU,AINS & FLT
	Put the port or cross-connect in the OOS,DSBLD administrative state.	OOS-MA,DSBLD
	Put the port or cross-connect in loopback.	OOS-AUMA,FLT & LPBK & MT

Table B-5 ONS 15600 Port and Cross-Connect Service State Transitions (continued)

Current Service State	Action	Next Service State
OOS-MA,DSBLD	Put the port or cross-connect in the IS administrative state.	IS-NR
	Put the port or cross-connect in the IS,AINS administrative state.	OOS-AU,AINS
	Put the port or cross-connect in the OOS,MT.	OOS-MA,MT
OOS-MA,LPBK & MT	Release the loopback.	OOS-MA,MT
	Alarm/condition is raised.	OOS-AUMA,FLT & LPBK & MT
OOS-MA,MT	Put the port or cross-connect in the IS administrative state.	IS-NR
	Put the port or cross-connect in the IS,AINS administrative state.	OOS-AU,AINS
	Put the port or cross-connect in the OOS,DSBLD.	OOS-MA,DSBLD
	Put the port or cross-connect in loopback.	OOS-MA,LPBK & MT
	Alarm/condition is raised.	OOS-AUMA,FLT & MT

Network Element Defaults

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This appendix describes the factory-configured (default) network element (NE) settings for the Cisco ONS 15600. It includes descriptions of card default settings and node default settings. For procedures for importing, exporting and editing the settings, refer to the "Maintain the Node" chapter of the *Cisco ONS 15600 Procedure Guide*. Cards supported by this platform that are not listed in this appendix are not supported by user-configurable NE defaults settings.

To change card settings individually (that is, without directly changing the NE defaults), refer to the "Change Card Settings" chapter of the *Cisco ONS 15600 Procedure Guide*. To change node settings, refer to the "Change Node Settings" chapter of the *Cisco ONS 15600 Procedure Guide*.

This appendix includes the following sections:

- C.1 Network Element Defaults Description, page C-1
- C.2 Card Default Settings, page C-2
- C.3 Node Default Settings, page C-29
- C.4 CTC Default Settings, page C-39

C.1 Network Element Defaults Description

The NE defaults are preinstalled on each Cisco ONS 15600 TSC card. They also ship as a file called 15454-defaults.txt on the Cisco Transport Controller (CTC) software CD in the event you want to import the defaults onto existing Timing and Shelf Controller (TSC) cards. The NE defaults include card-level, CTC, and node-level defaults.

Changes to card provisioning that are made manually using the "Change Card Settings" chapter in the *Cisco ONS 15600 Procedure Guide* override default settings. If you use the CTC Defaults editor (in the node view Provisioning > Defaults tab) or import a new defaults file, any changes to card or port settings that result only affect cards that are installed or preprovisioned after the defaults have changed.

Changes that are made manually to most node-level default settings override the current settings, whether default or provisioned. If you change node-level default settings, either by using the Defaults editor or by importing a new defaults file, the new defaults reprovision the node immediately for all

settings except those relating to protection (1+1 bidirectional switching, 1+1 reversion time, 1+1 revertive switching, bidirectional line switched ring [BLSR] ring reversion time, BLSR ring revertive switching, BLSR span reversion time, and BLSR span revertive switching), which apply to subsequent provisioning.

Note Changing some node-level provisioning via NE defaults can cause CTC disconnection or a reboot of the node in order for the provisioning to take effect. Before you change a default, check in the Side Effects column of the Defaults editor (right-click a column header and select **Show Column > Side Effects**) and be prepared for the occurrence of any side effects listed for that default.

C.2 Card Default Settings

The tables in this section list the default settings for each SONET card. Cisco provides several types of user-configurable defaults for Cisco ONS 15600 optical, electrical, storage access networking, and Ethernet (or data) cards. Types of card defaults can be broadly grouped by function, as outlined in the following subsections. For information about individual card settings, refer to the "Change Card Settings" chapter of the *Cisco ONS 15600 Procedure Guide*.

Note When the card level defaults are changed, the new provisioning done after the defaults have changed is affected. Existing provisioning remains unaffected.

The following types of defaults are defined for SONET cards.

C.2.1 Configuration Defaults

Card and port-level configuration defaults correspond to settings found in the CTC card-level Provisioning tabs.

Configuration defaults that correspond to settings that are reachable from the CTC card-level Provisioning tabs include the following types of options (arranged by CTC subtab):

- Line—(OC-N cards) Line-level configuration settings.
- SONET STS—(OC-N cards) SONET STS-level configuration settings.
- Pluggable Port Modules—(ASAP cards only) PPM (SFP) slot and port rate configuration settings.
- Optical—(ASAP cards only) OC-N rate port-level line configuration and SONET STS settings.
- Ethernet—(ASAP cards only) Ethernet port-level line configuration settings.

Note Ethernet line configuration defaults apply to both Ethernet port and packet-over-SONET (POS) port settings where the same setting exists for both.

Note For further information about supported features of each individual card, see Chapter 2, "Card Reference."

C.2.2 Threshold Defaults

Threshold default settings define the default cumulative values (thresholds) beyond which a threshold crossing alert (TCA) will be raised, making it possible to monitor the network and detect errors early.

Card threshold default settings are provided as follows:

- PM thresholds—(OC-N and ASAP cards) Can be expressed in counts or seconds; includes line, electrical path, and SONET thresholds.
- Physical Layer thresholds—(OC-N and ASAP cards) Expressed in percentages; includes optics thresholds.

Threshold defaults are defined for near end and/or far end, at 15-minute and one-day intervals. Thresholds are further broken down by type, such as Section, Line, or STS for performance monitoring (PM) thresholds, and TCA (warning) or Alarm for physical thresholds. PM threshold types define the layer to which the threshold applies. Physical threshold types define the level of response expected when the threshold is crossed.

Note For full descriptions of the thresholds you can set for each card, see Chapter 12, "Performance Monitoring."

Note For additional information regarding PM parameter threshold defaults as defined by Telcordia specifications, refer to Telcordia GR-820-CORE and GR-253-CORE.

C.2.3 Defaults by Card

In the tables that follow, card defaults are defined by the default name, its factory-configured value, and the domain of allowable values that you can assign to it.

Note Some default values, such as certain thresholds, are interdependent. Before changing a value, review the domain for that default and any other related defaults for potential dependencies.

C.2.3.1 OC192_4 Card Default Settings

Table C-1 lists the OC192-4 card default settings.

Table C-1 OC192_4 Card Default Settings

Default Name	Default Value	Default Domain
OC192_4.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
OC192_4.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
OC192_4.config.line.SendDoNotUse	FALSE	TRUE, FALSE
OC192_4.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
OC192_4.config.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
OC192_4.config.line.SyncMsgIn	TRUE	FALSE, TRUE

Table C-1 OC192_4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC192_4.config.sts.IPPMEnabled	FALSE	TRUE, FALSE
OC192_4.physicalthresholds.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
OC192_4.physicalthresholds.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
OC192_4.physicalthresholds.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
OC192_4.physicalthresholds.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
OC192_4.physicalthresholds.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
OC192_4.physicalthresholds.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
OC192_4.physicalthresholds.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
OC192_4.pmthresholds.line.farend.15min.CV	85040 (B2 count)	0 - 8850600
OC192_4.pmthresholds.line.farend.15min.ES	87 (seconds)	0 - 900
OC192_4.pmthresholds.line.farend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.line.farend.15min.SES	1 (seconds)	0 - 900
OC192_4.pmthresholds.line.farend.15min.UAS	3 (seconds)	0 - 900
OC192_4.pmthresholds.line.farend.1day.CV	850400 (B2 count)	0 - 849657600
OC192_4.pmthresholds.line.farend.1day.ES	864 (seconds)	0 - 86400
OC192_4.pmthresholds.line.farend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.line.farend.1day.SES	4 (seconds)	0 - 86400
OC192_4.pmthresholds.line.farend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.15min.CV	85040 (B2 count)	0 - 8850600
OC192_4.pmthresholds.line.nearend.15min.ES	87 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.line.nearend.15min.PSC	1 (count)	0 - 600
OC192_4.pmthresholds.line.nearend.15min.PSC-R	1 (count)	0 - 600
OC192_4.pmthresholds.line.nearend.15min.PSC-S	1 (count)	0 - 600
OC192_4.pmthresholds.line.nearend.15min.PSC-W	1 (count)	0 - 600
OC192_4.pmthresholds.line.nearend.15min.PSD	300 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.15min.PSD-R	300 (seconds)	0 - 900

Table C-1 OC192_4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC192_4.pmthresholds.line.nearend.15min.PSD-S	300 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.15min.PSD-W	300 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.15min.SES	1 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.15min.UAS	3 (seconds)	0 - 900
OC192_4.pmthresholds.line.nearend.1day.CV	850400 (B2 count)	0 - 849657600
OC192_4.pmthresholds.line.nearend.1day.ES	864 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.line.nearend.1day.PSC	5 (count)	0 - 57600
OC192_4.pmthresholds.line.nearend.1day.PSC-R	5 (count)	0 - 57600
OC192_4.pmthresholds.line.nearend.1day.PSC-S	5 (count)	0 - 57600
OC192_4.pmthresholds.line.nearend.1day.PSC-W	5 (count)	0 - 57600
OC192_4.pmthresholds.line.nearend.1day.PSD	600 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.PSD-R	600 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.PSD-S	600 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.PSD-W	600 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.SES	4 (seconds)	0 - 86400
OC192_4.pmthresholds.line.nearend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.section.nearend.15min.CV	10000 (B1 count)	0 - 7967700
OC192_4.pmthresholds.section.nearend.15min.ES	500 (seconds)	0 - 900
OC192_4.pmthresholds.section.nearend.15min.SEFS	500 (seconds)	0 - 900
OC192_4.pmthresholds.section.nearend.15min.SES	500 (seconds)	0 - 900
OC192_4.pmthresholds.section.nearend.1day.CV	100000 (B1 count)	0 - 764899200
OC192_4.pmthresholds.section.nearend.1day.ES	5000 (seconds)	0 - 86400
OC192_4.pmthresholds.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
OC192_4.pmthresholds.section.nearend.1day.SES	5000 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000
OC192_4.pmthresholds.sts1.farend.15min.ES	12 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.farend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts1.farend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.farend.15min.UAS	10 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts1.farend.1day.ES	100 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.farend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts1.farend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000

Table C-1 OC192_4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC192_4.pmthresholds.sts1.nearend.15min.ES	12 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.nearend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts1.nearend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
OC192_4.pmthresholds.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.nearend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.farend.15min.CV	75 (B3 count)	0 - 2160000
OC192_4.pmthresholds.sts12c+.farend.15min.ES	60 (seconds)	0 - 900
OC192_4.pmthresholds.sts12c+.farend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts12c+.farend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts12c+.farend.15min.UAS	10 (seconds)	0 - 900
OC192_4.pmthresholds.sts12c+.farend.1day.CV	750 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts12c+.farend.1day.ES	600 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.farend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts12c+.farend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.farend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.nearend.15min.CV	75 (B3 count)	0 - 2160000
OC192_4.pmthresholds.sts12c+.nearend.15min.ES	60 (seconds)	0 - 900
OC192_4.pmthresholds.sts12c+.nearend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts12c+.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts12c+.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts12c+.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts12c+.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts12c+.nearend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts12c+.nearend.15min.UAS	10 (seconds)	0 - 900

Table C-1 OC192_4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC192_4.pmthresholds.sts12c+.nearend.1day.CV	750 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts12c+.nearend.1day.ES	600 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.nearend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts12c+.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts12c+.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts12c+.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts12c+.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts12c+.nearend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts12c+.nearend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.farend.15min.CV	25 (B3 count)	0 - 2160000
OC192_4.pmthresholds.sts3c.farend.15min.ES	20 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.farend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts3c.farend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.farend.15min.UAS	10 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.farend.1day.CV	250 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts3c.farend.1day.ES	200 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.farend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts3c.farend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.farend.1day.UAS	10 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.nearend.15min.CV	25 (B3 count)	0 - 2160000
OC192_4.pmthresholds.sts3c.nearend.15min.ES	20 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.nearend.15min.FC	10 (count)	0 - 72
OC192_4.pmthresholds.sts3c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts3c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts3c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts3c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC192_4.pmthresholds.sts3c.nearend.15min.SES	3 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.nearend.15min.UAS	10 (seconds)	0 - 900
OC192_4.pmthresholds.sts3c.nearend.1day.CV	250 (B3 count)	0 - 207360000
OC192_4.pmthresholds.sts3c.nearend.1day.ES	200 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.nearend.1day.FC	40 (count)	0 - 6912
OC192_4.pmthresholds.sts3c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts3c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts3c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC192_4.pmthresholds.sts3c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000

Table C-1 OC192_4 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC192_4.pmthresholds.sts3c.nearend.1day.SES	7 (seconds)	0 - 86400
OC192_4.pmthresholds.sts3c.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.2 OC48_16 Card Default Settings

Table C-2 lists the OC48-16 card default settings.

Table C-2 OC48_16 Card Default Settings

Default Name	Default Value	Default Domain
OC48_16.config.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
OC48_16.config.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
OC48_16.config.line.SendDoNotUse	FALSE	TRUE, FALSE
OC48_16.config.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
OC48_16.config.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
OC48_16.config.line.SyncMsgIn	TRUE	FALSE, TRUE
OC48_16.config.sts.IPPMEnabled	FALSE	TRUE, FALSE
OC48_16.physicalthresholds.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
OC48_16.physicalthresholds.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
OC48_16.physicalthresholds.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
OC48_16.physicalthresholds.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
OC48_16.physicalthresholds.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
OC48_16.physicalthresholds.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
OC48_16.physicalthresholds.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
OC48_16.pmthresholds.line.farend.15min.CV	21260 (B2 count)	0 - 2212200
OC48_16.pmthresholds.line.farend.15min.ES	87 (seconds)	0 - 900
OC48_16.pmthresholds.line.farend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.line.farend.15min.SES	1 (seconds)	0 - 900
OC48_16.pmthresholds.line.farend.15min.UAS	3 (seconds)	0 - 900

Table C-2 OC48_16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC48_16.pmthresholds.line.farend.1day.CV	212600 (B2 count)	0 - 212371200
OC48_16.pmthresholds.line.farend.1day.ES	864 (seconds)	0 - 86400
OC48_16.pmthresholds.line.farend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.line.farend.1day.SES	4 (seconds)	0 - 86400
OC48_16.pmthresholds.line.farend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.15min.CV	21260 (B2 count)	0 - 2212200
OC48_16.pmthresholds.line.nearend.15min.ES	87 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.line.nearend.15min.PSC	1 (count)	0 - 600
OC48_16.pmthresholds.line.nearend.15min.PSC-R	1 (count)	0 - 600
OC48_16.pmthresholds.line.nearend.15min.PSC-S	1 (count)	0 - 600
OC48_16.pmthresholds.line.nearend.15min.PSC-W	1 (count)	0 - 600
OC48_16.pmthresholds.line.nearend.15min.PSD	300 (seconds)	0 - 600
OC48_16.pmthresholds.line.nearend.15min.PSD-R	300 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.15min.PSD-S	300 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.15min.PSD-W	300 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.15min.SES	1 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.15min.UAS	3 (seconds)	0 - 900
OC48_16.pmthresholds.line.nearend.1day.CV	212600 (B2 count)	0 - 212371200
OC48_16.pmthresholds.line.nearend.1day.ES	864 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.line.nearend.1day.PSC	5 (count)	0 - 57600
OC48_16.pmthresholds.line.nearend.1day.PSC-R	5 (count)	0 - 57600
OC48_16.pmthresholds.line.nearend.1day.PSC-S	5 (count)	0 - 57600
OC48_16.pmthresholds.line.nearend.1day.PSC-W	5 (count)	0 - 57600
OC48_16.pmthresholds.line.nearend.1day.PSD	600 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.PSD-R	600 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.PSD-S	600 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.PSD-W	600 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.SES	4 (seconds)	0 - 86400
OC48_16.pmthresholds.line.nearend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.section.nearend.15min.CV	10000 (B1 count)	0 - 2151900
OC48_16.pmthresholds.section.nearend.15min.ES	500 (seconds)	0 - 900
OC48_16.pmthresholds.section.nearend.15min.SEFS	500 (seconds)	0 - 900
OC48_16.pmthresholds.section.nearend.15min.SES	500 (seconds)	0 - 900
OC48_16.pmthresholds.section.nearend.1day.CV	100000 (B1 count)	0 - 206582400

Table C-2 OC48_16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC48_16.pmthresholds.section.nearend.1day.ES	5000 (seconds)	0 - 86400
OC48_16.pmthresholds.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
OC48_16.pmthresholds.section.nearend.1day.SES	5000 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts1.farend.15min.ES	12 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.farend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.sts1.farend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.farend.15min.UAS	10 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts1.farend.1day.ES	100 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.farend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts1.farend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts1.nearend.15min.ES	12 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.nearend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts1.nearend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
OC48_16.pmthresholds.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.nearend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.farend.15min.CV	75 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts12c+.farend.15min.ES	60 (seconds)	0 - 900
OC48_16.pmthresholds.sts12c+.farend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.sts12c+.farend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts12c+.farend.15min.UAS	10 (seconds)	0 - 900

Table C-2 OC48_16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC48_16.pmthresholds.sts12c+.farend.1day.CV	750 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts12c+.farend.1day.ES	600 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.farend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts12c+.farend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.farend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.nearend.15min.CV	75 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts12c+.nearend.15min.ES	60 (seconds)	0 - 900
OC48_16.pmthresholds.sts12c+.nearend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.sts12c+.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts12c+.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts12c+.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts12c+.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts12c+.nearend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts12c+.nearend.15min.UAS	10 (seconds)	0 - 900
OC48_16.pmthresholds.sts12c+.nearend.1day.CV	750 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts12c+.nearend.1day.ES	600 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.nearend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts12c+.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts12c+.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts12c+.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts12c+.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts12c+.nearend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts12c+.nearend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.farend.15min.CV	25 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts3c.farend.15min.ES	20 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.farend.15min.FC	10 (count)	0 - 72
OC48_16.pmthresholds.sts3c.farend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.farend.15min.UAS	10 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.farend.1day.CV	250 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts3c.farend.1day.ES	200 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.farend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts3c.farend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.farend.1day.UAS	10 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.nearend.15min.CV	25 (B3 count)	0 - 2160000
OC48_16.pmthresholds.sts3c.nearend.15min.ES	20 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.nearend.15min.FC	10 (count)	0 - 72

Table C-2 OC48_16 Card Default Settings (continued)

Default Name	Default Value	Default Domain
OC48_16.pmthresholds.sts3c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts3c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts3c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts3c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
OC48_16.pmthresholds.sts3c.nearend.15min.SES	3 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.nearend.15min.UAS	10 (seconds)	0 - 900
OC48_16.pmthresholds.sts3c.nearend.1day.CV	250 (B3 count)	0 - 207360000
OC48_16.pmthresholds.sts3c.nearend.1day.ES	200 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.nearend.1day.FC	40 (count)	0 - 6912
OC48_16.pmthresholds.sts3c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts3c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts3c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts3c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
OC48_16.pmthresholds.sts3c.nearend.1day.SES	7 (seconds)	0 - 86400
OC48_16.pmthresholds.sts3c.nearend.1day.UAS	10 (seconds)	0 - 86400

C.2.3.3 ASAP Card Default Settings

Table C-3 lists the ASAP card default settings.

Table C-3 ASAP Card Default Settings

Default Name	Default Value	Default Domain
ASAP_4.config.ether.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
ASAP_4.config.ether.State	OOS,DSBLD	IS, OOS,DSBLD, OOS,MT, IS,AINS
ASAP_4.config.oc12.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
ASAP_4.config.oc12.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
ASAP_4.config.oc12.line.SendDoNotUse	FALSE	TRUE, FALSE
ASAP_4.config.oc12.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
ASAP_4.config.oc12.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
ASAP_4.config.oc12.line.SyncMsgIn	TRUE	FALSE, TRUE
ASAP_4.config.oc12.sts.IPPMEnabled	FALSE	TRUE, FALSE
ASAP_4.config.oc192.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
ASAP_4.config.oc192.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
ASAP_4.config.oc192.line.SendDoNotUse	FALSE	TRUE, FALSE
ASAP_4.config.oc192.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.config.oc192.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
ASAP_4.config.oc192.line.SyncMsgIn	TRUE	FALSE, TRUE
ASAP_4.config.oc192.sts.IPPMEnabled	FALSE	TRUE, FALSE
ASAP_4.config.oc3.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
ASAP_4.config.oc3.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
ASAP_4.config.oc3.line.SendDoNotUse	FALSE	TRUE, FALSE
ASAP_4.config.oc3.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
ASAP_4.config.oc3.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
ASAP_4.config.oc3.line.SyncMsgIn	TRUE	FALSE, TRUE
ASAP_4.config.oc3.sts.IPPMEnabled	FALSE	TRUE, FALSE
ASAP_4.config.oc48.line.AINSSoakTime	08:00 (hours:mins)	00:00, 00:15, 00:30 .. 48:00
ASAP_4.config.oc48.line.SDBER	1.00E-07	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
ASAP_4.config.oc48.line.SendDoNotUse	FALSE	TRUE, FALSE
ASAP_4.config.oc48.line.SFBER	1.00E-04	1E-3, 1E-4, 1E-5
ASAP_4.config.oc48.line.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
ASAP_4.config.oc48.line.SyncMsgIn	TRUE	FALSE, TRUE
ASAP_4.config.oc48.sts.IPPMEnabled	FALSE	TRUE, FALSE
ASAP_4.physicalthresholds.oc12.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.alarm.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc12.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.alarm.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc12.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.alarm.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc12.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc12.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc12.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.physicalthresholds.oc12.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc12.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc12.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc12.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc192.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.alarm.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc192.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.alarm.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc192.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.alarm.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc192.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc192.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc192.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc192.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc192.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc192.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc192.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc3.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.alarm.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.physicalthresholds.oc3.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.alarm.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc3.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.alarm.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc3.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc3.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc3.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc3.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc3.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc3.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc3.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc48.alarm.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.alarm.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc48.alarm.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.alarm.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc48.alarm.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.alarm.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc48.warning.15min.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.15min.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc48.warning.15min.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.15min.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.physicalthresholds.oc48.warning.15min.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.15min.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.physicalthresholds.oc48.warning.1day.LBC-HIGH	200 (%)	LBC-LOW, LBC-LOW + 1, LBC-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.1day.LBC-LOW	20 (%)	0, 1, 2 .. LBC-HIGH
ASAP_4.physicalthresholds.oc48.warning.1day.OPR-HIGH	200 (%)	OPR-LOW, OPR-LOW + 1, OPR-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.1day.OPR-LOW	50 (%)	-1, 0, 1 .. OPR-HIGH
ASAP_4.physicalthresholds.oc48.warning.1day.OPT-HIGH	120 (%)	OPT-LOW, OPT-LOW + 1, OPT-LOW + 2 .. 255
ASAP_4.physicalthresholds.oc48.warning.1day.OPT-LOW	80 (%)	0, 1, 2 .. OPT-HIGH
ASAP_4.pmthresholds.oc12.line.farend.15min.CV	5315 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc12.line.farend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.line.farend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.farend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.farend.1day.CV	53150 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc12.line.farend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.line.farend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.nearend.15min.CV	5315 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc12.line.nearend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.line.nearend.15min.PSC	1 (count)	0 - 600
ASAP_4.pmthresholds.oc12.line.nearend.15min.PSC-W	0 (count)	0 - 600
ASAP_4.pmthresholds.oc12.line.nearend.15min.PSD	300 (seconds)	0 - 600
ASAP_4.pmthresholds.oc12.line.nearend.15min.PSD-W	0 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.nearend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.nearend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.line.nearend.1day.CV	53150 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc12.line.nearend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.line.nearend.1day.PSC	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc12.line.nearend.1day.PSC-W	0 (count)	0 - 57600
ASAP_4.pmthresholds.oc12.line.nearend.1day.PSD	600 (seconds)	0 - 86400

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc12.line.nearend.1day.PSD-W	0 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.nearend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.line.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.section.nearend.15min.CV	10000 (B1 count)	0 - 2151900
ASAP_4.pmthresholds.oc12.section.nearend.15min.ES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.section.nearend.15min.SEFS	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.section.nearend.15min.SES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.section.nearend.1day.CV	100000 (B1 count)	0 - 206582400
ASAP_4.pmthresholds.oc12.section.nearend.1day.ES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.section.nearend.1day.SES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts1.farend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts1.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts1.farend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts1.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.farend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts12c+.farend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts12c+.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.farend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts12c+.farend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts12c+.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts12c+.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.15min.UAS	10 (seconds)	0 - 900

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc12.sts3c-9c.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.farend.15min.CV	85040 (B2 count)	0 - 8850600
ASAP_4.pmthresholds.oc192.line.farend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.line.farend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.farend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.farend.1day.CV	850400 (B2 count)	0 - 849657600
ASAP_4.pmthresholds.oc192.line.farend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.line.farend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.nearend.15min.CV	85040 (B2 count)	0 - 8850600
ASAP_4.pmthresholds.oc192.line.nearend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.FC	10 (count)	0 - 72

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSC	1 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSC-R	1 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSC-S	1 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSC-W	1 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSD	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSD-R	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSD-S	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.PSD-W	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.1day.CV	850400 (B2 count)	0 - 849657600
ASAP_4.pmthresholds.oc192.line.nearend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSC	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSC-R	5 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSC-S	5 (count)	0 - 600
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSC-W	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSD	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSD-R	600 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSD-S	600 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.line.nearend.1day.PSD-W	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.nearend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.line.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.section.nearend.15min.CV	10000 (B1 count)	0 - 7967700
ASAP_4.pmthresholds.oc192.section.nearend.15min.ES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.section.nearend.15min.SEFS	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.section.nearend.15min.SES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.section.nearend.1day.CV	100000 (B1 count)	0 - 764899200
ASAP_4.pmthresholds.oc192.section.nearend.1day.ES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.section.nearend.1day.SES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts1.farend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts1.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.sts1.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts1.farend.15min.UAS	10 (seconds)	0 - 900

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc192.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts1.farend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts1.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.farend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts12c+.farend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.sts12c+.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.farend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts12c+.farend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts12c+.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.FC	10 (count)	0 - 72

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts12c+.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts3c-9c.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.ES	200 (seconds)	0 - 86400

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc192.sts3c-9c.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.farend.15min.CV	1312 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc3.line.farend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.line.farend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.farend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.farend.1day.CV	13120 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc3.line.farend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.line.farend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.nearend.15min.CV	1312 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc3.line.nearend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.line.nearend.15min.PSC	1 (count)	0 - 600
ASAP_4.pmthresholds.oc3.line.nearend.15min.PSC-W	0 (count)	0 - 600
ASAP_4.pmthresholds.oc3.line.nearend.15min.PSD	300 (seconds)	0 - 600
ASAP_4.pmthresholds.oc3.line.nearend.15min.PSD-W	0 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.nearend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.nearend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.line.nearend.1day.CV	13120 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc3.line.nearend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.line.nearend.1day.PSC	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc3.line.nearend.1day.PSC-W	0 (count)	0 - 57600
ASAP_4.pmthresholds.oc3.line.nearend.1day.PSD	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.nearend.1day.PSD-W	0 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.nearend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.line.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.section.nearend.15min.CV	10000 (B1 count)	0 - 2151900

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc3.section.nearend.15min.ES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.section.nearend.15min.SEFS	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.section.nearend.15min.SES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.section.nearend.1day.CV	100000 (B1 count)	0 - 206582400
ASAP_4.pmthresholds.oc3.section.nearend.1day.ES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.section.nearend.1day.SES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc3.sts1.farend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.sts1.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc3.sts1.farend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.sts1.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.farend.15min.CV	25 (B3 count)	0 - 2160000

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc3.sts3c.farend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.sts3c.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.farend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc3.sts3c.farend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.sts3c.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc3.sts3c.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.farend.15min.CV	21260 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc48.line.farend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.line.farend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.farend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.farend.1day.CV	212600 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc48.line.farend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.line.farend.1day.SES	4 (seconds)	0 - 86400

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc48.line.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.15min.CV	21260 (B2 count)	0 - 2212200
ASAP_4.pmthresholds.oc48.line.nearend.15min.ES	87 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSC	1 (count)	0 - 600
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSC-R	1 (count)	0 - 600
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSC-S	1 (count)	0 - 600
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSC-W	1 (count)	0 - 600
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSD	300 (seconds)	0 - 600
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSD-R	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSD-S	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.15min.PSD-W	300 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.15min.SES	1 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.15min.UAS	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.line.nearend.1day.CV	212600 (B2 count)	0 - 212371200
ASAP_4.pmthresholds.oc48.line.nearend.1day.ES	864 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSC	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSC-R	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSC-S	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSC-W	5 (count)	0 - 57600
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSD	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSD-R	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSD-S	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.PSD-W	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.SES	4 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.line.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.section.nearend.15min.CV	10000 (B1 count)	0 - 2151900
ASAP_4.pmthresholds.oc48.section.nearend.15min.ES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.section.nearend.15min.SEFS	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.section.nearend.15min.SES	500 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.section.nearend.1day.CV	100000 (B1 count)	0 - 206582400
ASAP_4.pmthresholds.oc48.section.nearend.1day.ES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.section.nearend.1day.SEFS	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.section.nearend.1day.SES	5000 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.farend.15min.CV	15 (B3 count)	0 - 2160000

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc48.sts1.farend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts1.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.farend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts1.farend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts1.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.CV	15 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.ES	12 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.CV	125 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.ES	100 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts1.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts12c+.farend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc48.sts12c+.farend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts12c+.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.farend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts12c+.farend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts12c+.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts12c+.farend.1day.SES	7 (seconds)	0 - 86400

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc48.sts12c+.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.CV	75 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.ES	60 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.CV	750 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.ES	600 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts12c+.nearend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.farend.1day.UAS	10 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.CV	25 (B3 count)	0 - 2160000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.ES	20 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.FC	10 (count)	0 - 72
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.NPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.NPJC-PGEN	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.PPJC-PDET	60 (count)	0 - 7200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.PPJC-PGEN	60 (count)	0 - 7200000

Table C-3 ASAP Card Default Settings (continued)

Default Name	Default Value	Default Domain
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.SES	3 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.15min.UAS	10 (seconds)	0 - 900
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.CV	250 (B3 count)	0 - 207360000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.ES	200 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.FC	40 (count)	0 - 6912
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.NPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.NPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.PPJC-PDET	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.PPJC-PGEN	5760 (count)	0 - 691200000
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.SES	7 (seconds)	0 - 86400
ASAP_4.pmthresholds.oc48.sts3c-9c.nearend.1day.UAS	10 (seconds)	0 - 86400

C.3 Node Default Settings

Table C-4 on page C-30 lists the node-level default settings for the Cisco ONS 15600. Cisco provides the following user-configurable defaults for each Cisco ONS 15600 node:

- Circuit settings—Set the administrative state and path protection circuit defaults.
- General settings—Set general node management defaults, including whether to use Daylight Savings Time (DST), the IP address of the NTP/SNTP server to be used, the time zone where the node is located, the SD path BER value, the defaults description, and whether to report loopback conditions on Out-of-Service, Maintenance (OOS-MT) state ports.
- Network settings—Set default gateway node type, and whether to raise an alarm when the backplane LAN cable is disconnected.
- OSI settings—Set Open System Interconnection (OSI) main setup, generic routing encapsulation (GRE) tunnel, link access protocol on the D channel (LAP-D), router subnet, and TID address resolution protocol (TARP) settings.
- 1+1 protection settings—Set whether or not protected circuits have bidirectional switching, are revertive, and what the reversion time is.
- BLSR protection settings—Set whether BLSR-protected circuits are revertive, and what the reversion time is, at both the ring and span levels.
- Legal Disclaimer—Set the legal disclaimer that warns users at the login screen about the possible legal or contractual ramifications of accessing equipment, systems, or networks without authorization.
- Security Grant Permissions—Set default user security levels for activating/reverting software, performance monitoring data clearing, database restoring, and retrieving audit logs.
- Security Access settings—Set default security settings for LAN access, shell access, serial craft access, element management system (EMS) access (including Internet Inter-Object Request Broker Protocol [IIOP] listener port number), TL1 access, and SNMP access.
- Security RADIUS settings—Set default RADIUS server settings for accounting port number, authentication port number, and whether to enable the node as a final authenticator.

- Security Policy settings—Set the allowable failed logins before lockout, idle user timeout for each user-level, optional lockout duration or manual unlock enabled, password reuse and change frequency policies, number of characters difference between the old and new password, password aging by security level, enforced single concurrent session per user, and option to disable inactive user after a set inactivity period.
- BITS Timing settings—Set the coding, framing, and state settings for building integrated timing supply 1 (BITS-1) and BITS2 timing.
- General Timing settings—Set the mode (External, Line, or Mixed), quality of reserved (RES) timing (set the rule that defines the order of clock quality from lowest to highest), revertive, reversion time, and SSM message set for node timing.

Note Any node level defaults changed using the **Provisioning > Defaults** tab, changes existing node level provisioning. Although this is service affecting, it depends on the type of defaults changed, for example, general, and all timing and security attributes. The "Changing default values for some node level attributes overrides the current provisioning." message is displayed. The Side Effects column of the Defaults editor (right-click a column header and select **Show Column > Side Effects**) explains the effect of changing the default values. However, when the card level defaults are changed using the **Provisioning > Defaults** tab, existing card provisioning remains unaffected.

Note For more information about each individual node setting, refer to the "Change Node Settings" chapter of the *Cisco ONS 15600 Procedure Guide*.

Table C-4 Node Default Settings

Default Name	Default Value	Default Domain
NODE.circuits.State	IS,AINS	IS, OOS,DSBLD, OOS,MT, IS,AINS
NODE.circuits.upsr.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.circuits.upsr.Revertive	FALSE	TRUE, FALSE
NODE.circuits.upsr.STS_SDBER	1.00E-06	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
NODE.circuits.upsr.STS_SFBER	1.00E-04	1E-3, 1E-4, 1E-5
NODE.circuits.upsr.VT_SDBER	1.00E-06	1E-5, 1E-6, 1E-7, 1E-8, 1E-9
NODE.circuits.upsr.VT_SFBER	1.00E-04	1E-3, 1E-4, 1E-5
NODE.general.DefaultsDescription	Factory Defaults	Free form field

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.general.NtpSntpServer	0.0.0.0	IP Address
NODE.general.ReportLoopbackConditionsOnOOS-MTPorts	FALSE	FALSE, TRUE
NODE.general.TimeZone	(GMT-06:00) Central Time (US & Canada)	(For applicable time zones, see Table C-5.)
NODE.general.UseDST	TRUE	TRUE, FALSE
NODE.network.general.AlarmMissingBackplaneLAN	FALSE	TRUE, FALSE
NODE.network.general.GatewaySettings	None	LeaveAsIs, None, ENE, GNE, ProxyOnlyNode
NODE.osi.greTunnel.OspfCost	110	110 - 65535
NODE.osi.greTunnel.SubnetMask	24 (bits)	8, 9, 10 .. 32
NODE.osi.lapd.Mode	AITS	AITS, UITS
NODE.osi.lapd.MTU	512	512, 513, 514 .. 1500
NODE.osi.lapd.Role	Network	Network, User
NODE.osi.lapd.T200	200 (ms)	200, 300, 400 .. 20000
NODE.osi.lapd.T203	10000 (ms)	4000, 4100, 4200 .. 120000
NODE.osi.mainSetup.L1L2LSPBufferSize	512 (bytes)	512 - 1500
NODE.osi.mainSetup.L1LSPBufferSize	512 (bytes)	512 - 1500
NODE.osi.mainSetup.NodeRoutingMode	Intermediate System Level 1/Level 2	Intermediate System Level 1, Intermediate System Level 1/Level 2
NODE.osi.subnet.DISPriority	63	1, 2, 3 .. 127
NODE.osi.subnet.ESH	10 (sec)	10, 20, 30 .. 1000
NODE.osi.subnet.IIH	3 (sec)	1, 2, 3 .. 600

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.osi.subnet.ISH	10 (sec)	10, 20, 30 .. 1000
NODE.osi.subnet.LANISISCost	20	1, 2, 3 .. 63
NODE.osi.subnet.LDCCISISCost	40	1, 2, 3 .. 63
NODE.osi.subnet.SDCCISISCost	60	1, 2, 3 .. 63
NODE.osi.tarp.L1DataCache	TRUE	FALSE, TRUE
NODE.osi.tarp.L2DataCache	FALSE	FALSE, TRUE
NODE.osi.tarp.LANStormSuppression	TRUE	FALSE, TRUE
NODE.osi.tarp.LDB	TRUE	FALSE, TRUE
NODE.osi.tarp.LDBEntry	5 (min)	10-Jan
NODE.osi.tarp.LDBFlush	5 (min)	0 - 1440
NODE.osi.tarp.PDUsL1Propagation	TRUE	FALSE, TRUE
NODE.osi.tarp.PDUsL2Propagation	TRUE	FALSE, TRUE
NODE.osi.tarp.PDUsOrigination	TRUE	FALSE, TRUE
NODE.osi.tarp.T1Timer	15 (sec)	0 - 3600
NODE.osi.tarp.T2Timer	25 (sec)	0 - 3600
NODE.osi.tarp.T3Timer	40 (sec)	0 - 3600
NODE.osi.tarp.T4Timer	20 (sec)	0 - 3600
NODE.osi.tarp.Type4PDUDelay	0 (sec)	0 - 255
NODE.protection.1+1.BidirectionalSwitching	FALSE	TRUE, FALSE
NODE.protection.1+1.ReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.1+1.Revertive	FALSE	TRUE, FALSE
NODE.protection.blsr.RingReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0
NODE.protection.blsr.RingRevertive	TRUE	TRUE, FALSE
NODE.protection.blsr.SpanReversionTime	5.0 (minutes)	0.5, 1.0, 1.5 .. 12.0

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.protection.blsr.SpanRevertive	TRUE	TRUE, FALSE
NODE.security.emsAccess.AccessState	NonSecure	NonSecure, Secure
NODE.security.emsAccess.IIOPListenerPort (May reboot node)	57790 (port #)	0 - 65535
NODE.security.grantPermission.ActivateRevertSoftware	Superuser	Provisioning, Superuser
NODE.security.grantPermission.PMClearingPrivilege	Provisioning	Provisioning, Superuser
NODE.security.grantPermission.RestoreDB	Superuser	Provisioning, Superuser
NODE.security.grantPermission.RetrieveAuditLog	Superuser	Provisioning, Superuser
NODE.security.idleUserTimeout.Maintenance	01:00 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Provisioning	00:30 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Retrieve	00:00 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.idleUserTimeout.Superuser	00:15 (hours:mins)	00:00, 00:01, 00:02 .. 16:39
NODE.security.lanAccess.LANAccess (May disconnect CTC from node)	Front & Backplane	No LAN Access, Front Only, Backplane Only, Front & Backplane
NODE.security.lanAccess.RestoreTimeout	5 (minutes)	0 - 60

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.security.legalDisclaimer.LoginWarningMessage	<html> WARNING This system is restricted to authorized users for business purposes. Unauthorized<p>access is a violation of the law. This service may be monitored for administrative<p>and security reasons. By proceeding, you consent to this monitoring.	Free form field
NODE.security.other.DisableInactiveUser	FALSE	FALSE, TRUE
NODE.security.other.InactiveDuration	45 (days)	1, 2, 3 .. 99 when DisableInactiveUser TRUE; 45 when DisableInactiveUser FALSE
NODE.security.other.SingleSessionPerUser	FALSE	TRUE, FALSE
NODE.security.passwordAging.EnforcePasswordAging	FALSE	TRUE, FALSE
NODE.security.passwordAging.maintenance.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.maintenance.WarningPeriod	5 (days)	20-Feb
NODE.security.passwordAging.provisioning.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.provisioning.WarningPeriod	5 (days)	20-Feb
NODE.security.passwordAging.retrieve.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.retrieve.WarningPeriod	5 (days)	20-Feb

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.security.passwordAging.superuser.AgingPeriod	45 (days)	20 - 90
NODE.security.passwordAging.superuser.WarningPeriod	5 (days)	20-Feb
NODE.security.passwordChange.CannotChangeNewPassword	FALSE	TRUE, FALSE
NODE.security.passwordChange.CannotChangeNewPasswordForNDays	20 (days)	20 - 95
NODE.security.passwordChange.NewPasswordMustDifferFromOldByNCharacters	1 (characters)	5-Jan
NODE.security.passwordChange.PreventReusingLastNPasswords	1 (times)	10-Jan
NODE.security.passwordChange.RequirePasswordChangeOnFirstLoginToNewAccount	FALSE	TRUE, FALSE
NODE.security.radiusServer.AccountingPort	1813 (port)	0 - 32767
NODE.security.radiusServer.AuthenticationPort	1812 (port)	0 - 32767
NODE.security.radiusServer.EnableNodeAsFinalAuthenticator	TRUE	FALSE, TRUE
NODE.security.serialCraftAccess.EnableCraftPortA	TRUE	TRUE, FALSE
NODE.security.serialCraftAccess.EnableCraftPortB	TRUE	TRUE, FALSE
NODE.security.shellAccess.AccessState	NonSecure	Disabled, NonSecure, Secure
NODE.security.shellAccess.EnableShellPassword	FALSE	TRUE, FALSE
NODE.security.shellAccess.TelnetPort	23	23 - 9999
NODE.security.snmpAccess.AccessState	NonSecure	Disabled, NonSecure
NODE.security.tl1Access.AccessState	NonSecure	Disabled, NonSecure, Secure
NODE.security.userLockout.FailedLoginsAllowedBeforeLockout	5 (times)	0 - 10
NODE.security.userLockout.LockoutDuration	00:30 (mins:secs)	00:00, 00:05, 00:10 .. 10:00
NODE.security.userLockout.ManualUnlockBySuperuser	FALSE	TRUE, FALSE
NODE.timing.bits-1.Coding	B8ZS	B8ZS, AMI
NODE.timing.bits-1.Framing	ESF	ESF, D4
NODE.timing.bits-1.State	IS	IS, OOS,DSBLD, OOS,MT, IS,AINS

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.timing.bits-2.Coding	B8ZS	B8ZS, AMI
NODE.timing.bits-2.Framing	ESF	ESF, D4
NODE.timing.bits-2.State	IS	IS, OOS,DSBLD, OOS,MT, IS,AINS
NODE.timing.general.Mode	External	External, Line
NODE.timing.general.QualityOfRES	RES=DUS	PRS<RES, STU<RES<PRS, ST2<RES<STU, ST3<RES<ST2, SMC<RES<ST3, ST4<RES<SMC, RES<ST4, RES=DUS when SSMMessage Set Generation 1; PRS<RES, STU<RES<PRS, ST2<RES<STU, TNC<RES<ST2, ST3E<RES<TNC, ST3<RES<ST3E, SMC<RES<ST3, ST4<RES<SMC, RES<ST4, RES=DUS when SSMMessage Set Generation 2
NODE.timing.general.ReversionTime	0.0 (minutes)	0.0, 0.5, 1.0 .. 12.0

Table C-4 Node Default Settings (continued)

Default Name	Default Value	Default Domain
NODE.timing.general.Revertive	FALSE	TRUE, FALSE
NODE.timing.general.SSMMessageSet	Generation 2	Generation 1, Generation 2

C.3.1 Time Zones

Table C-5 lists the time zones that apply for node time zone defaults. Time zones in the table are ordered by their relative relationships to Greenwich Mean Time (GMT), and the default values are displayed in the correct format for valid default input.

Table C-5 Time Zones

Time Zone (GMT +/– Hours)	Default Value
GMT-11:00	(GMT-11:00) Midway Islands, Samoa
GMT-10:00	(GMT-10:00) Hawaiian Islands, Tahiti
GMT-09:00	(GMT-09:00) Anchorage - Alaska
GMT-08:00	(GMT-08:00) Pacific Time (US & Canada), Tijuana
GMT-07:00	(GMT-07:00) Mountain Time (US & Canada)
GMT-07:00	(GMT-07:00) Phoenix - Arizona
GMT-06:00	(GMT-06:00) Central Time (US & Canada)
GMT-06:00	(GMT-06:00) Mexico City
GMT-06:00	(GMT-06:00) Costa Rica, Managua, San Salvador
GMT-06:00	(GMT-06:00) Saskatchewan
GMT-05:00	(GMT-05:00) Bogota, Lima, Quito
GMT-05:00	(GMT-05:00) Eastern Time (US & Canada)
GMT-05:00	(GMT-05:00) Havana
GMT-05:00	(GMT-05:00) Indiana (US)
GMT-04:00	(GMT-04:00) Asuncion
GMT-04:00	(GMT-04:00) Caracas, La Paz, San Juan
GMT-04:00	(GMT-04:00) Atlantic Time (Canada), Halifax, Saint John, Charlottetown
GMT-04:00	(GMT-04:00) Santiago
GMT-04:00	(GMT-04:00) Thule (Qaanaaq)
GMT-03:30	(GMT-03:30) St. John's - Newfoundland
GMT-03:00	(GMT-03:00) Brasilia, Rio de Janeiro, Sao Paulo
GMT-03:00	(GMT-03:00) Buenos Aires, Georgetown

Table C-5 Time Zones (continued)

Time Zone (GMT +/– Hours)	Default Value
GMT-03:00	(GMT-03:00) Godthab (Nuuk) - Greenland
GMT-02:00	(GMT-02:00) Mid-Atlantic
GMT-01:00	(GMT-01:00) Azores, Scoresbysund
GMT-01:00	(GMT-01:00) Praia - Cape Verde
GMT 00:00	(GMT 00:00) Casablanca, Reykjavik, Monrovia
GMT	(GMT) Greenwich Mean Time
GMT 00:00	(GMT 00:00) Dublin, Edinburgh, London, Lisbon
GMT+01:00	(GMT+01:00) Amsterdam, Berlin, Rome, Stockholm, Paris
GMT+01:00	(GMT+01:00) Belgrade, Bratislava, Budapest, Ljubljana, Prague
GMT+01:00	(GMT+01:00) Brussels, Copenhagen, Madrid, Vienna
GMT+01:00	(GMT+01:00) Sarajevo, Skopje, Sofija, Vilnius, Warsaw, Zagreb
GMT+01:00	(GMT+01:00) West Central Africa, Algiers, Lagos, Luanda
GMT+01:00	(GMT+01:00) Windhoek (Namibia)
GMT+02:00	(GMT+02:00) Al Jizah, Alexandria, Cairo
GMT+02:00	(GMT+02:00) Amman
GMT+02:00	(GMT+02:00) Athens, Bucharest, Istanbul
GMT+02:00	(GMT+02:00) Beirut
GMT+02:00	(GMT+02:00) Cape Town, Harare, Johannesburg, Pretoria
GMT+02:00	(GMT+02:00) Jerusalem
GMT+02:00	(GMT+02:00) Kaliningrad, Minsk
GMT+03:00	(GMT+03:00) Aden, Antananarivo, Khartoum, Nairobi
GMT+03:00	(GMT+03:00) Baghdad
GMT+03:00	(GMT+03:00) Kuwait, Riyadh
GMT+03:00	(GMT+03:00) Moscow, St. Petersburg, Novgorod
GMT+03:30	(GMT+03:30) Tehran
GMT+04:00	(GMT+04:00) Abu Dhabi, Mauritius, Muscat
GMT+04:00	(GMT+04:00) Aqtau, T'bilisi
GMT+04:00	(GMT+04:00) Baku
GMT+04:00	(GMT+04:00) Yerevan, Samara
GMT+04:30	(GMT+04:30) Kabul
GMT+05:00	(GMT+05:00) Chelyabinsk, Prem, Yekaterinburg, Ufa
GMT+05:00	(GMT+05:00) Islamabad, Karachi, Tashkent
GMT+05:30	(GMT+05:30) Calcutta, Mumbai, New Delhi, Chennai
GMT+05:45	(GMT+05:45) Kathmandu
GMT+06:00	(GMT+06:00) Almaty
GMT+06:00	(GMT+06:00) Colombo, Dhaka, Astana

Table C-5 Time Zones (continued)

Time Zone (GMT +/– Hours)	Default Value
GMT+06:00	(GMT+06:00) Novosibirsk, Omsk
GMT+06:30	(GMT+06:30) Cocos, Rangoon
GMT+07:00	(GMT+07:00) Bangkok, Hanoi, Jakarta
GMT+07:00	(GMT+07:00) Krasnoyarsk, Norilsk, Novokuznetsk
GMT+08:00	(GMT+08:00) Irkutsk, Ulaan Bataar
GMT+08:00	(GMT+08:00) Beijing, Shanghai, Hong Kong, Urumqi
GMT+08:00	(GMT+08:00) Perth
GMT+08:00	(GMT+08:00) Singapore, Manila, Taipei, Kuala Lumpur
GMT+09:00	(GMT+09:00) Chita, Yakutsk
GMT+09:00	(GMT+09:00) Osaka, Sapporo, Tokyo
GMT+09:00	(GMT+09:00) Palau, Pyongyang, Seoul
GMT+09:30	(GMT+09:30) Adelaide, Broken Hill
GMT+09:30	(GMT+09:30) Darwin
GMT+10:00	(GMT+10:00) Brisbane, Port Moresby, Guam
GMT+10:00	(GMT+10:00) Canberra, Melbourne, Sydney
GMT+10:00	(GMT+10:00) Hobart
GMT+10:00	(GMT+10:00) Khabarovsk, Vladivostok
GMT+10:30	(GMT+10:30) Lord Howe Island
GMT+11:00	(GMT+11:00) Honiara, Magadan, Soloman Islands
GMT+11:00	(GMT+11:00) Noumea - New Caledonia
GMT+11:30	(GMT+11:30) Kingston - Norfolk Island
GMT+12:00	(GMT+12:00) Andyra, Kamchatka
GMT+12:00	(GMT+12:00) Auckland, Wellington
GMT+12:00	(GMT+12:00) Marshall Islands, Eniwetok
GMT+12:00	(GMT+12:00) Suva - Fiji
GMT+12:45	(GMT+12:45) Chatham Island
GMT+13:00	(GMT+13:00) Nuku'alofa - Tonga
GMT+13:00	(GMT+13:00) Rawaki, Phoenix Islands
GMT+14:00	(GMT+14:00) Line Islands, Kiritimati - Kiribati

C.4 CTC Default Settings

Table C-6 on page C-40 lists the CTC-level default settings for the Cisco ONS 15600. Cisco provides the following user-configurable defaults for CTC:

- Automatic Routing—Set circuit creation with the Route Automatically check box selected by default.

- Network Circuit Automatic Routing Overridable—Set by default whether or not a user creating circuits can change (override) the Automatic Circuit Routing setting (also provisionable as a default). When this default is set to TRUE it enables users to change whether or not Route Automatically is selected in the check box. When this default is set to FALSE it ensures that users cannot change the Route Automatically setting while creating circuits in CTC.

Note When the Route Automatically check box is not selectable (and is not checked) during circuit creation, the following automatic routing sub-options are also unavailable: Using Required Nodes/Spans, Review Route Before Creation.

- Create TL1-like—Set whether to create only TL1-like circuits; that is, instruct the node to create only cross-connects, allowing the resulting circuits to be in an upgradable state.
- Local domain creation and viewing—Set whether domains that you create and view persist globally (all CTC sessions), or only locally (within the current CTC session).
- Network Map—Set the default network map (which country's map is displayed in CTC network view).

Table C-6 CTC Default Settings

Default Name	Default Value	Default Domain
CTC.circuits.CreateLikeTL1	FALSE	TRUE, FALSE
CTC.circuits.RouteAutomatically	TRUE	TRUE, FALSE
CTC.circuits.RouteAutomaticallyDefaultOverridable	TRUE	TRUE, FALSE
CTC.network.LocalDomainCreationAndViewing	FALSE	TRUE, FALSE
CTC.network.Map	United States	-none-, Germany, Japan, Netherlands, South Korea, United Kingdom, United States

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